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Street Cleaning in Kansas City

Study of methods employed, made by Public Service Institute, shows that the cart patrol as used in that city is the most expensive method employed. Study of costs suggests abandoning this and investigating relative efficiency, adaptability and economy of several types of street cleaning apparatus.

The Kansas City Public Service Institute during the past year has made a study of the methods employed by the Public Works Department in cleaning the streets of that city and has submitted a report on the same to the Director of Public Works and the Commissioner of Street Cleaning. They report that these officials agree with them that the unit of cost of cleaning in other than business districts is too high and can be reduced, and have agreed to conduct experiments in one or more districts to determine the relative efficiency and cost by various methods. "The results of the experiments will serve as a guide in determining the type of cleaning to be used throughout the residential districts."

Of the 673 miles of paved streets and boulevards in the city, 97 are in boulevards and are not cleaned by the Street Cleaning Division, but 576 miles or 8,962,000 square yards of paved streets are cleaned by this Division, while the Park Department cleans the boulevards, representing about two million square yards.

Of the area cleaned by the Street Cleaning Division, about one million square yards is in the downtown district and is cleaned every day, the balance on an average once in two weeks, some being cleaned daily and some not oftener than once a month.

Cleaning the streets of Kansas City is performed by the Division of Street Cleaning of the Department of Public Works. The work done is roughly divided into five classes. 1. Flushing. 2. Hand sweeping. 3. Horsedrawn carts and men with brooms and shovels, known as Cart Patrol. 4. Cleaning sewers and catch basins. 5. Upkeep and repairs of barns and stables and the care of horses.

Under the director is a commissioner of street cleaning and a deputy commissioner, and under these are three district foremen, one for each district. The force includes four chauffeurs and four laboreres, with two flushers, who flush approximately eight hundred thousand square yards daily; fifteen foremen with thirty cartmen, forty-four laborers and two chauffeurs clean approximately 800,000 square yards daily by the cart patrol method; two foremen, forty-five laborers and one chauffeur clean approximately 750,-

FLUSHING STREET IN KANSAS CITY

000 square yards by the hand patrol method daily. One foreman and two laborers with a small truck clean catch basins and sewers.

The city uses two motor driven power flushers, one a 1500 gallon double unit Pierce Arrow and the other a 1500 gallon double unit White. Both are equipped with power driven pumps and front and side nozzles which may be adjusted to any desired height. Only one of the two front nozzles is used in Kansas City, the drivers stating that one nozzle in front supplies enough water. About one million square yards of streets are flushed with these flushers, about 800,000 square yards daily and the balance three times a week. Over one half of this area is flushed at night. Each flusher averages about 200,000 square yards or fifteen miles of street during eight hours, but the investigators report that this is too high a speed for efficient results and in some cases little more than sprinkling is effected. Most of the area covered by flushing is also covered by hand patrol.

In hand sweeping, each man with a broom, shovel and pushcart goes to work at 7:00 A. M. and follows both gutters, picking up papers in the street and on the sidewalks. He usually sweeps the entire length of the block along the gutter and then turns on a hydrant, washing the loose dirt along the gutter to the catch basin. Most of the territory is cleaned twice daily by this method and the balance once a day. The investigators state that hand sweeping work appears to be excellent and very good results are obtained.

At odd times during the day, each sweeper opens a hydrant, allowing the water to flow for several minutes along the gutter. Observations indicate that the hydrants are opened on an average of five minutes at a time. Calculation made during the investigation indicated that about 210 cubic feet of water was discharged during a five-minute flushing period, but later actual measurements indicated that only about half this amount really was used. Under normal conditions, it was calculated that at least 870 hydrants were opened each day on the average.

Based on observations made during the week of May 8th to 15th, the investigators estimate that about 125 cubic feet of water is used to a thousand square yards cleaned by hand sweeping. At the lowest rate of 6 cents per hundred cubic feet this equals about $60 per day for the total cost of water used by the patrol broom men, or 7½ cents per thousand square yards cleaned.

In cleaning by cart patrol, a foreman with two one-horse carts and drivers and from two to four laborers with brooms and shovels operate in the street to be cleaned, taking both sides of the street, sweeping into piles, and shoveling into the carts the refuse material, after which hydrants are opened and gutters washed. The area covered by horse-drawn carts represents eighty percent of the total street area to be cleaned or 7,800,000 square yards. Streets are cleaned by this method on the average of once in two weeks, although one district requires four weeks to

OUTFIT USED IN HAND SWEEPING

cover it. Cleaning by this method is practically confined to gutters, and only the coarse material and heaviest debris are picked up. One disadvantage of this cleaning is the location of dumps, about four or five loads a day being all that one cart can remove owing to the long haul. It was estimated that about 135 cubic feet of water per day from the hydrants was used to a thousand square yards in this method of cleaning. The value of this water would be about 8 cents per thousand square yards per day.

The total cost of cleaning by each of the methods was calculated upon observations made during the week of May 8th to 15th. These include costs of labor, water, gas, oil and interest and depreciation. For flushing, the depreciation was figured on a five year basis, with interest at six percent on the original investment. For flushing, the salary and wages of four chauffeurs and four laborers during the week averaged 4.5 cents per thousand square yards, the cost of water 2.3 cents, operation of machines 2.0 cents and interest and depreciation 1.6 cents, a total of 10.4 cents per thousand square yards.

For hand sweeping the costs were as follows: —Foremen's salaries 1.4 cents, labor 27 cents, water 7.5 cents, miscellaneous expense, interest and depreciation 0.8 cents, gasoline, oil and repairs for pickup truck 0.9 cents, brooms and repairs 0.9 cents, a total of 38.5 cents. Cleaning by cart patrol was estimated to cost as follows:— Foremen's salaries 8.6 cents per thousand square yards, labor 41.6 cents, water 8.0 cents, hay and grain 2.2 cents, repairs 3.6 cents and interest and depreciation 0.8 cents, a total of 64.8 cents per thousand square yards.

The commission compared these costs with those reported by other cities, most of them of about the size of Kansas City or larger. These cities report the cost of cleaning by use of the pickup sweeper, including the expense of disposing of the sweepings, is about 25 cents per thousand yards, varying from a minimum of 13 cents to a maximum of 41 cents, depending upon the smoothness of the pavement, the topography, and the system of management. Los Angeles reported the cost of auto pickup sweeping at 14.5 cents, Buffalo 30.8 cents, Chicago, 26.5 cents, and Rockford, Illinois 41 cents. These figures in-

cluded interest and depreciation, and cost of supervision. Cost of cleaning by vacuum sweeping was reported at 10 cents to 79 cents, the average being 30 cents. Cleaning by horsedrawn brooms was about 20 cents per thousand square yards. From the figures presented it was estimated that during the week of the investigation there would have been a saving of about $1600 if pickup sweepers had been used instead of the cart patrol method, or of $2500 if flushing had been used.

The report ends with a number of suggestions, preceded by the statement: "One fact stands out above all others in this study of street cleaning methods and costs: **Kansas City cleans the greater portion of its streets by the most expensive and least effective method.**"

The suggestions are as follows:

1. That plans be made to abandon the cart patrol system so far as possible and as quickly as new methods can be substituted.
2. That the relative efficiency, adaptability, and economy of the several types of street cleaning apparatus be investigated, and so far as possible tested in actual demonstration on Kansas City's streets.

CART PATROL ON KANSAS CITY STREET

3. That the city be divided into districts best adapted to the various methods of cleaning.
4. That the organization be modified to conform to the new methods.
5. That a complete cost record and reporting system be installed.
6. That the most effective methods of operating the present flushers be determined by actual study and continued by careful supervision.
7. That opening of hydrants by hand and cart patrol cleaners be abandoned as rapidly as possible.
8. That adequate inspection of building construction etc., be provided in order that provisions of ordinances and regulations to prevent unnecessary littering of streets can be enforced.

Street Cleaning in St. Paul

The latest annual report by the Commissioner of Public Works of the city of St. Paul shows that the city contains 391 miles of streets which are graded only, 24 miles of macadam roads, 196 miles of paved streets, and 11 miles of paved alleys. The paved areas, including streets, bridges and alleys, total 4,487,000 square yards. Of this area, 1,365,000 square yards is cleaned by hand sweeping under the patrol system. The area allotted to each sweeper varies from 3,200 square yards in the business district, to 17,000 square yards in the residential sections.

In addition to the sweeping, all paved streets are cleaned periodically with water by means of flushers, 140 miles of streets being flushed. In the retail district the streets are flushed every night, while in the outlying districts flushing is done as required.

Use of Street Cleaning Machines

Summary of information received last month by PUBLIC WORKS in response to questionnaire. Percentage of each size class of cities using each kind of machine.

Although most cities, especially the larger ones, continue the use of hand brooms for cleaning street pavements, a very large percentage of them have, during the past few years, adopted a greater or less number of mechanical appliances for this purpose. The appliances in common use may be classified as horse-drawn machine brooms, motor-driven machine brooms, pick-up sweepers, flushing machines, and vacuum sweepers. Of all the cities reporting, 30% last year used horse-drawn machine brooms, 4% used motor brooms, 30% used pick-up sweepers, 52% used flushing machines and 5 cities used vacuum sweepers.

It is, perhaps, even more interesting to note the use of the different classes of machines by cities of different sizes. We have divided the cities into classes of those under 10,000—which number 41% of the total; those of 10,000 to 20,000—20%; those of 20,000 to 100,000—20%; and those of over 100,000—19%.

Of the cities under 10,000 (some of which were

TYPE OF FLUSHER USED IN KANSAS CITY

Street Cleaning Machines Used During Latest Fiscal Year
Percentage of cities of each size-class reporting use of each kind of machine.

	Cities under 10,000 population	Cities of 10,000 to 20,000	Cities of 20,000 to 100,000	Cities of over 100,000	Totals
Machine brooms, horse-drawn	32%	36%	—	50%	30%
Machine brooms, motor driven	—	—	9%	10%	4%
Pick-up sweepers	23%	9%	55%	40%	30%
Flushing machines	45%	36%	46%	90%	52%
New Kinds of Equipment Adopted During Past Three Years					
Machine brooms, motor driven	—	9%	9%	—	4%
Pick-up sweepers	18%	—	27%	10%	15%
Flushing machines	9%	—	9%	—	5½%

as small as 4,000), we find 32% last year used horse-drawn brooms, none used motor brooms, 23% used pick-up sweepers, 45% used flushing machines, and one city used a vacuum sweeper.

Of the cities of 10,000 to 20,000 population, 36% used horse-drawn brooms, none used motor brooms, 9% used pick-up sweepers, and 36% used flushing machines.

Of the cities of 20,000 to 100,000 population none used horsedrawn brooms, 9% used motor brooms, 55% used pick-up sweepers, 46% used flushing machines, and one city used vacuum sweepers.

Of the largest cities, of over 100,000 population, 50% used horsedrawn brooms, 10% used motor brooms, 40% used pick-up sweepers, 90% used flushing machines, and 3 cities used vacuum sweepers.

Most cities continue to use expensive machinery of this kind until it is practically worn out, even though they may have decided to change to a new type of equipment as soon as opportunity offers. It is, therefore, a better indication of the tendency in machinery of this class to learn what changes have been made recently in the type of machine purchased than what machines are in use. We find that during the past three years none of the cities of the smallest class have adopted the use of motor machine brooms, but 18% have adopted the use of pick-up sweepers, and one city the use of flushing machines. Of cities of 10,000 to 20,000 population, 9% have adopted the motor machine brooms, but none of the others of this class have changed over to any of the other appliances, possibly because they were already in use prior to three years ago. Of cities of 20,000 to 100,000 population, we find that 9% have recently changed to motor brooms, 27% to pick-up sweepers, and 9% to flushing machines. Of the largest cities, one has recently adopted pick-up sweepers, and one city vacuum sweepers.

The fact that horse-drawn machine brooms are not included in the list of newly adopted methods does not mean, of course, that they are not being used, but rather that they were in general use prior to three years ago. This is shown by the statement concerning apparatus used, wherein it was stated that 30% of all the cities used horse-drawn brooms.

The vacuum sweeper is a comparatively new machine and an expensive one and it is therefore not to be wondered that comparatively few are yet in use, although it is interesting to find that some of the smaller cities have purchased them. Perhaps the most striking figures are those indicating the very little use made of motor machine brooms. Apparently the horse-drawn broom is considered much more favorably, some of the larger cities even abandoning the motor drawn brooms but continuing the horse drawn.

Refuse Disposal in Letchworth

Letchworth, the first and probably the most successful of the "Garden Cities" of England, had an estimated population last year of a little over 13,000. It was designed to be an industrial as well as a residential community and has so developed, containing 52 factories and 35 workshops.

Up to the year 1920 house refuse was disposed of by dumping into shallow sand pits, but this became a nuisance because of rats and burning rubbish and the council considered disposal by destructor and by pulverization. The latter was adopted, one reason being the lower cost of installation; and another that, the city being situated in the midst of an agricultural district, it would be easy to dispose of the fine products of the system.

The pulverizer is driven by a 35 horsepower electric motor. The refuse is dumped on a floor and from this is fed by hand to a hopper; tin cans, rags, bottles, metal and other materials being sorted out for sale. The remaining refuse is then pulverized and sold to farmers for fertilizing and lightening the soil, the price paid being 1 shilling (about 24 cents) per load at the plants. At first some difficulty was experienced in convincing the farmers of the value of this dust, but they now appreciate it and a ready sale is effected, especially for growing root crops and for dressing heavy land.

Tin cans are pressed in bales by a power press and sold, as are also bottles, metals, bones and some rags. The market for tin cans is a very uncertain one and at the present time prices are rather low, so that a credit to the plant of only about 22 cents per ton is obtainable, while the cost of operation is about $1.00 and the interest and sinking funds charges total about $0.80. This leaves a net cost of operation of something over $1.50 a ton. The cost of operation includes $0.64 for labor, $0.18 a ton for electricity, $0.12 for heaters, and $0.07½ for oil, grease, repairs, etc.

This plant is in the center of the town, reducing the hauling of refuse to a minimum.

Resurfacing Old Pavement With Standard Asphalt Surface

By P. L. Brockway*

There has been considerable discussion from time to time as to the best methods of construction to be used in renovating an old block pavement by covering it with a standard surface of sheet asphalt or asphaltic concrete. There seems to be a general impression that some rather mysterious methods of preparation of the old pavement are necessary and that there is considerable question as to the results to be obtained by whatever method of construction is used.

The installation of an underground utility under an old pavement in the city of Wichita, Kansas, has given opportunity to observe the results obtained in such a project. The original pavement was constructed in 1889. The concrete base is of very poor quality six inches in thickness, on which was spread one to two inches of sand for a cushion. The wearing surface was paved with brick approximately two by four by eight inches, such as were in common use at that time. These brick naturally are of such a grade that they would be entirely destroyed under a standard rattler test and even though the streeet carried a very light traffic for a great many years they became so badly worn that the construction of some new pavement became necessary after the old pavement was about twenty years old.

The central station for the housing of fire fighting apparatus, built adjoining the street about this time, accelerated the destruction of the pavement to such a point that the brick began to break through and ravel out in spots. The original filler was cement grout of fair quality.

In 1912 the street was resurfaced under the following procedure. Spots in the old surface which were loose were removed and the sand cleaned out to the original base, the hole being filled up practically level with cement concrete. Minor depressions up to a couple of inches in depth were leveled up with what was commonly known then as close binder, but is an asphalt mixture containing enough sand to make it fairly dense and corresponding in a general way to black base specifications without the largest aggregate. The original pavement was laid with the brick extending entirely from curb to curb. A narrow strip was removed on either side of the street and a concrete gutter built up on the old base of sufficient height to give approximately a two-inch shoulder along the outer edge. The surface of the pavement was swept clean with street brooms and a very light paint coat of cutback asphalt applied by whipping it on with stubby brooms. No attempt was made to made a solid sheet of asphalt coating over the old brick because of the resultant softening in the surface and as a matter of fact later work of the same kind has entirely omitted this quasi-paint coat.

*City engineer of Wichita, Kansas.

On the street so prepared was placed a sheet asphalt surface two inches in thickness of standard specifications in use at that time. Asphalt of about fifty-six penetration was used, running about 10½ per cent A. C. with the filler about a point lower. This surface has been in use for fourteen years with the traffic gradually increasing and including heavier and heavier motor driven fire fighting apparatus. A recent traffic count under normal traffic conditions indicated between five and six thousand vehicles per day using the street, about 20 per cent of which is truck traffic.

The only maintenance ever done on the street consisted of skin patching some waves which developed after about twelve years' service. By skin patching is meant merely sweeping off the pavement where it has become wavy and then dashing on a small amount of asphaltic cement and leveling up the pavement with a thin coat of sheet asphalt mixture. This repair was made in 1924.

In 1926 a continuous cut was made in the pavement about two feet wide, for the installation of a utility, using air-driven pavement breaking chisels, taking out first the surface in approximately rectangular pieces. The photograph was made of some of these pieces as they were piled along the curb along with the other debris. The cut was made almost directly in the center of the main line of traffic in one direction. The photograph shows, without much explanation, just what the action of the traffic had done to the pavement, forcing the lower surface of the asphalt down into every crevice in the old brick. The ridges shown on the under side of the asphalt surface vary from a quarter of an inch to an inch in depth. The small fragment of the surface almost directly in the center of the photograph,

ASPHALT SURFACE REMOVED FROM BRICK PAVEMENT BASE

turned edgewise to the camera, shows the thickness of the skin patch by the difference in texture of the material at its right edge. The imprint of the brick furnish a very good scale dimension. The clay tile ducts in the background are about four inches interior diameter.

It is apparent from the facts indicated in this photograph, that an old block pavement having a surface of fairly uniform contour but roughened by the wear on the edges of the blocks, provides an almost ideal base to prevent shoving of the bituminous surface mixture. This is further supported by the excellent service record of the mixture, which was designed much softer and more liable to surface displacements than present day practice.

Czechoslovakia Highways

The highway administration of Czechoslovakia last year built a test road using fourteen various types of pavements, all of a width of 5 meters (about 16½ feet). Of this test highway, a length of 75 meters was small stone block type, 75 meters was concrete road 15 centimeters thick, 75 meters was concrete road with upper layer of reinforced concrete (Kleinlogel system) 15 centimeters thick, 100 meters was macadam gravel with a mortar layer, 100 meters was macadam gravel grouted, 100 meters was macadam gravel pitch grouted, 100 meters was coal tar macadam (Aeberli), 100 meters was tar macadam mixed with "Tomatit," 100 meters macadam of limestone gravel and sand mixed with aquatic glass, 100 meters basalt gravel and sand with aquatic glass and mixed with "Via Vitrea," 75 meters of rolled macadam mixed with "Viadur," 85 meters of coarse gravel macadam, and 85 meters of macadam of normal basalt gravel. It was also planned to construct 85 meters of each of the following roads: Rolled road tarred with "Viadur" on the surface, rolled road tarred by rectified coal tar on the surface, and a rolled road oiled on the surface with "Impregnol," but construction of these three was postponed because of unfavorable weather conditions.

The section of road referred to was opened to traffic on October 1st, 1925. The Ministry of Public Works intends to construct another test section where the work will be on a larger scale and so far as possible by the use of road constructing machines.

In the maintenance of the public roads of Czechoslovakia, the Ministry of Public Works during the past year was limited by finances to the most urgent repairs of roads which had been damaged and had been neglected during the war. The roads of the country consist of state highroads which connect the most densely populated centers of the country and carry the greatest part of the motor traffic. Of a total of 72,000 kilometers of public roads, about 8,400 are state high roads and about 48,000 are district roads. Only about 267 kilometers of the state highroads are paved, because of the expense.

Effect of Size of Brick on Rattler Loss[1]

Study made by Bureau of Public Roads to determine correction factors for use in connection with a revision of the present standard rattler test of paving brick.

By F. H. JACKSON, Engineer of Tests, United States Bureau of Public Roads

It has long been recognized that for brick of equal quality but differing in size the comparative rattler losses are not directly proportional to the differences in weight. Therefore, any system of rating based on the percentage of loss by weight, irrespective of the difference in size, is incorrect unless a correction is introduced covering this feature or unless independent standards are set up for each size separately.

In the very elaborate series of tests presented by Blair and Orton before the American Society for Testing Materials in 1911,[2] upon which our present standard method of test is largely based, no mention is made of the effect of size on rattler loss. This was probably due to the fact that at that time the bulk of the paving brick manufactured were of the so-called "standard block" size—that is, about 3 to 3½ inches in width, 4 inches in depth, and 8 to 9 inches in length. Professor Talbot, however, in his paper on "Qualities of High Grade Paving Brick," published in Bulletin 9 of the Illinois State Geological Survey,[3] states that, although he has not studied the effect of the size of brick on the rattler loss, "it is established that the brick size will sustain a greater loss than the block size of the same grade and quality. * * * The amount of this difference depends upon various conditions, but with good material the brick sizes may be expected to lose, say, 3 per cent more than the block sizes."

It has only been within comparatively recent years that the thinner brick, such as those made to lay to a depth of 3 inches and 2½ inches, have come into general use. Efforts have also been made from time to time to introduce certain odd sizes, such as the 3 by 3½ by 8½ inch, and others in which the length varied slightly. The

[1]Paper presented at the annual meeting of the American Society for Testing Materials.

[2]"A Study of the Rattler Test for Paving Brick," M. W. Blair and Edward Orton, jr., Proc. A. S. T. M., Vol. XI, 1911, p. 776.

[3]Illinois State Geological Survey Bul. 9, "Paving Brick and Paving Brick Clays of Illinois."

number of sizes of brick in use, however, has been greatly curtailed within the last three years through the efforts of the permanent committee on Simplification of Variety and Standards of Paving Brick of the Department of Commerce. At the present time this committee recognizes two sizes of brick, as follows: 3½ by 4 by 8½ inches, and 3 by 4 by 8½ inches. In addition to these two sizes, the 2½ by 4 by 8½ inch size is coming into rather general use, so that it will in all probability in the near future be included in the series of recognized sizes.

Recognizing the injustice of specifying the same percentage of wear for both 3-inch and 3½-inch brick, many paving engineers, when they began using the thinner brick for construction, adopted the practice of inserting certain arbitrary correction factors in their specifications so as to bring these sizes into line with the requirements for the so-called "standard block" size. So far as the writer is aware, however, none of these correction factors was based upon extensive test data. As a rule, they were the result of theoretical consideration.

In view of the fact that committee C-3 of the American Society for Testing Materials has undertaken to rearrange the standard specifications and methods of test for paving brick, C 7-15, in order to bring it into conformity with the society's present standards as to form, it seemed an excellent opportunity to investigate this relationship experimentally with a view to furnishing a table of correction factors which might be inserted in the standard.

TESTS MADE ON FIVE SIZES OF BRICK

Fortunately, a rather unusual opportunity existed for obtaining such data. The Bureau of Public Roads has had under way for the last several months an investigation to determine the relation between the depth of the paving brick wearing course and the resistance of the pavement to the action of traffic. This investigation is being conducted by the bureau in cooperation with the National Paving Brick Manufacturers Association, which furnished a large quantity of brick for this purpose. These brick were all from the same plant and were manufactured as a special lot so as to be as nearly uniform in quality as possible. They were of the plain wire-cut type, and the average rattler loss on the 3½ by 4 by 8½ inch was about 17 per cent. Five sizes of brick were furnished, all of the same width and length but varying in depth from 2 to 4 inches by ½-inch steps.

It was decided, therefore, in addition to the major investigation, the results of which will be reported later, to make an incidental study of the effect of size on rattler loss, using the five sizes of brick on hand. For this purpose 10 standard rattler tests were made on each size of brick, making 50 tests in all. Every precaution was taken to keep the standard rattler calibrated, and every detail as called for in standard procedure was followed. The results for the first series of rattler tests are given in Table 1. Upon studying the results it became immediately apparent

Table 1—Rattler Test Results on Brick Used to Determine Effect of Size

Sample No.	Percentage of loss in weight Thickness of brick (inches) 2	2½	3	3½	4
	Per cent	Per cent	Per cent	Per cent	Per cent
1	22.6	17.9	18.6	17.4	17.3
2	22.0	21.4	18.3	16.8	16.5
3	23.1	18.3	19.7	16.8	16.4
4	21.9	18.3	19.7	16.5	16.3
5	22.8	19.1	18.7	16.2	17.0
6	22.8	19.3	19.7	17.0	17.1
7	22.7	19.0	18.6	17.2	16.3
8	22.9	17.6	19.3	17.0	17.2
9	24.7	19.2	19.1	18.0	17.4
10	23.3	17.9	18.2	17.4	16.6
Average	22.9	18.8	19.0	17.0	16.8
Maximum	24.7	21.4	19.7	18.0	17.4
Minimum	21.9	17.6	18.2	16.2	16.3

that there was no constant relation between the average percentage of loss and the size of the brick. This at once suggested the possibility that the various sizes of brick might not all be of the same quality. In order to throw light upon this important point, a number of brick of each size were subjected to a special hardness test, using the Dorry hardness machine for testing rock. One-inch cores were drilled with a diamond drill from the center of each brick, and subjected to the abrasive action of quartz sand fed upon a revolving steel disk upon which the brick core was held under a standard pressure. The loss in weight of the specimen at 2,500 revolutions of the disk was considered to be a true measure of its hardness.

Realizing that hardness is not the only quality of a paving brick which affects the rattler loss, tests for crushing strength and transverse strength were also made. Crushing strengths were determined on half brick, tested on edge, five tests of each size being made. The brick were bedded in plaster of Paris before testing. Tests for transverse strength were made in two ways, (1) by using a special form of equalizer apparatus developed at the Bureau of Standards,

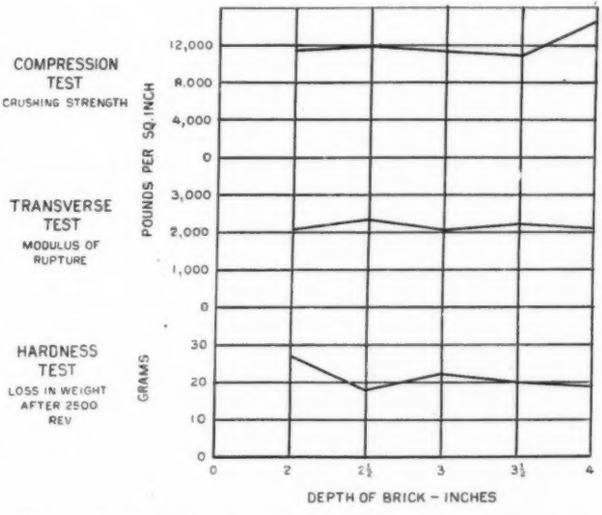


FIG. 1.—RESULTS OF HARDNESS TEST, TRANSVERSE TEST AND COMPRESSION TEST ON BRICKS VARYING IN DEPTH FROM 2 TO 4 INCHES

and (2), by the use of the A. S. T. M. standard apparatus somewhat modified by the Bureau of Public Roads. Details of the results of the transverse tests, discussed from the standpoint of comparative methods of testing, wlll be published elsewhere. For the purpose of this discussion, the results of the tests by both methods were averaged. Each average is the results of 40 tests.

A very brief study of these tests is in order with a view to determining what differences in quality exist between the various sizes. It will be seen at once that the tests are not altogether consistent. For instance, the 4-inch size has a considerably higher crushing strength than any of the other sizes. This difference, however, is not reflected in any of the other tests, which is, of course, not surprising when we consider that each of these tests measures a specific property of the brick. When taken as a whole, however, the results give a general idea of the relative quality of the five sizes under consideration which, in this case, is what we are after. Assuming for the moment that the resistance of brick in the rattler is influenced by both hardness and toughness and that these qualities are measured individually probably better by the hardness test and the transverse test than by any of the others, it is found that from the standpoint of hardness the 2-inch brick are considerably softer than any of the other sizes; the 3-inch are next; and the 2½-inch are the hardest. In transverse strength the 2½-inch size ranks highest; the 3½-inch next; with the 2-inch, 3-inch and 4-inch practically identical. Taking both tests into consideration, the brick may be tentatively rated relatively as to quality about as follows: 2½-inch, 3½-inch, 4-inch, 3-inch, 2-inch. It should be borne in mind, of course, that these differences are not large numerically, and are of significance only because of the special use to which the rattler tests will now be put.

EFFECT OF SIZE ON RATTLER LOSS

In Figure 2 are plotted the average losses in pounds for each size of brick against the initial weight of the brick charge. There are also plotted two series of points, one above and the other below the actual losses, which show what the losses would have been if they had been (1) directly proportional to the number of linear inches of edge exposed to wear, and (2) directly proportional to weight (or volume). It will be seen that the actual curve is somewhat below a line bisecting the angle formed by the two theoretical curves, which indicates that the correction to be applied to the small sizes is somewhat smaller than has been commonly used on the assumption that the loss takes place principally on the edges and corners of the brick.

Returning now to a discussion of the actual losses, it is found that the plotted points do not lie on a straight line as they would were the brick all of the same quality and the differences in loss due entirely to the effect of size. Plotting the average line, it is found that the losses for the 2½-inch and 3½-inch sizes lie below the

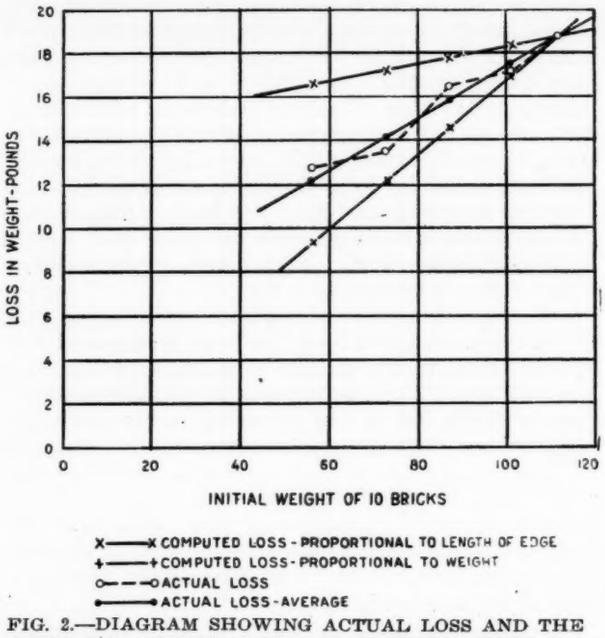


FIG. 2.—DIAGRAM SHOWING ACTUAL LOSS AND THE AVERAGE ACTUAL LOSS OF VARIOUS SIZES OF BRICK IN THE RATTLER TEST. THERE IS ALSO SHOWN WHAT THE LOSSES WOULD HAVE BEEN HAD THE LOSS BEEN PROPORTIONAL TO THE LINEAR INCHES OF EDGE EXPOSED TO WEAR AND TO THE WEIGHT OF BRICKS

line, whereas those for the 2-inch and 3-inch sizes lie above the line. This grouping is exactly what would be expected as a result of our study of the relative quality of the five sizes based on the hardness and transverse tests, and indicates that these tests are a reliable measure of those properties of the paving brick which are affected by the rattler test.

One would seem justified, therefore, in drawing the average line as indicated on the chart,

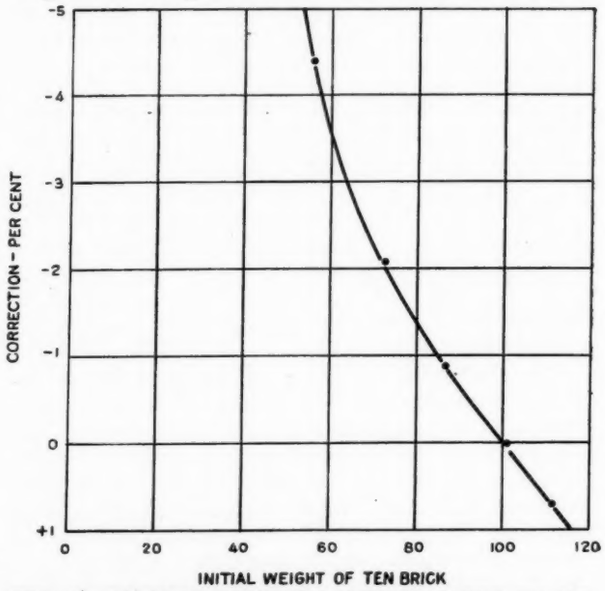


FIG. 3.—DIAGRAM SHOWING PERCENTAGES TO BE ADDED TO OR SUBTRACTED FROM OBSERVED RATTLER TEST LOSS TO GIVE RESULTS IN TERMS OF "STANDARD" 10-POUND BRICK

and recomputing the various percentages of loss from the corrected losses obtained therefrom. This gives a series of values the same as would have been obtained experimentally had all the brick been of the same quality. Using these values, a correction curve has been plotted as shown in Figure 3. By means of the chart it is possible to determine what percentage shall be added to or subtracted from the observed rattler loss to give the equivalent value in terms of a "standard" 10-pound brick. The corrections, it will be observed, are based entirely on weight and not on nominal size. Although it might be more convenient to use the latter method, it would seem unwise to do so because of the wide variations in actual size of brick of the same nominal size. For instance, among eight brands tested by the bureau in connection with this work, it was found that for the 2½-inch size the actual weights of 10 brick varied from 64 to 75 pounds, whereas for the 3-inch size the corresponding variation was from 82 to 89 pounds. These differences, of course, are accounted for in part by differences in specific gravity of the material. In general, however, the differences in size appear to be more pronounced, as will be observed by noting Figure 4, in which are plotted the average weights and corresponding volumes for each of the brands and sizes of brick tested.

It will be observed that the points lie fairly well on a straight line, those above the line indicating the lighter brick, whereas those below the line indicate the heavier brick. Of course, a correction based on the volume of brick would be the most rational method because it would eliminate variations in the volume-weight relations owing to differences in specific gravity. However, the weight determination is much simpler and more readily made, and it would not appear that the small changes in specific gravity which normally occur in well-burned paving brick would seriously affect the accuracy of the corrections.

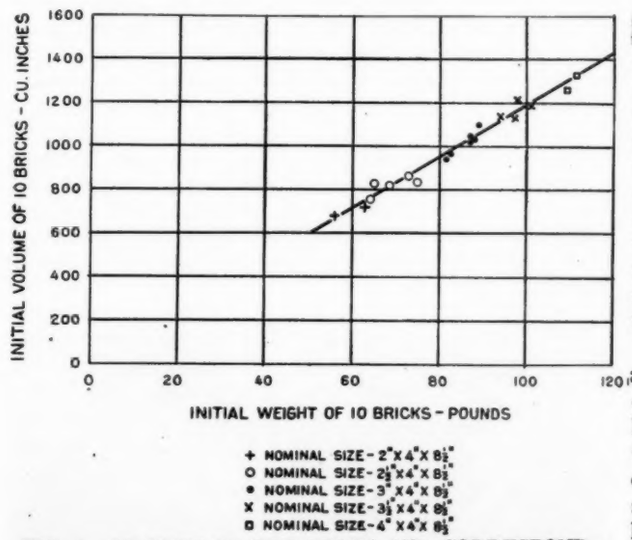


FIG. 4.—WEIGHT OF TEN BRICK AND CORRESPONDING VOLUME FOR EACH OF THE SIZES AND BRANDS OF BRICK TESTED

SUPPLEMENTARY CHECK TESTS

In order to determine to what extent the proposed correction curve could be applied in actual work, a series of check tests was run on a number of different brands of paving brick submitted by the manufacturers at the request of the National Paving Brick Manufacturers Association. Each brand was represented by at least two sizes, and in some cases by three sizes. Control tests for hardness and for modulus of rupture were likewise run, in order to check the quality of the brick by tests independent of the size factor. Unfortunately, the number of brick available for these supplementary tests was so limited that it was found impossible to obtain a sufficient number of tests for hardness and modulus of rupture to obtain representative averages.

The results of the rattler tests on six lots of brick, representing four brands of plain, wire-cut-lug, shale brick and two brands of plain, wire-cut, fire-clay brick are shown in Table 2,

Table 2.—Check Tests of Paving Brick

Lot No.	Nominal size	Volume of 10 brick	Weight of 10 brick	Rattler loss	Corrected loss	Total variations within lots Before correction	Total variations within lots After correction
	Inches	Cubic inches	Pounds	Per cent	Per cent	Per cent	Per cent
1.....	3	1,009	87	24.2	23.3	..	..
	2	720	63	28.1	24.8	3.9	1.5
2.....	3½	1,219	98	19.9	19.8	..	..
	3	1,113	89	21.3	20.6	1.4	.8
3.....	3½	1,128	97	16.1	15.9	..	..
	3	1,028	87	16.7	15.8	..	..
	2½	838	75	17.8	15.9	1.7	.1
4.....	4	1,256	109	17.0	17.5	..	..
	3	974	83	17.9	16.7	..	..
	2½	762	64	18.3	15.2	1.3	2.3
5.....	3½	1,141	94	17.1	16.8	..	..
	2½	831	65	21.0	18.0	3.9	1.2
6.....	3½	1,156	94	19.7	19.3	..	..
	2½	811	64	23.2	20.1	3.5	.8

together with their initial volumes and weights and the corrected percentage of loss derived from the use of the correction curve shown in Figure 3. Each value for per cent of wear represents the average of three tests. It will be observed that in all cases but one the differences in percentage between the corrected losses for the different sizes in any given lot are considerably less that the corresponding differences before correction. In only one case, however, that of lot 3, have these differences entirely disappeared, indicating that a certain amount of the original variation was due to differences in the quality of the brick. This is not surprising when it is remembered that no special effort in any case was made to obtain brick of exactly the same quality. In one case, that of lot 4, the results of the individual rattler tests were very erratic, indicating an extremely nonuniform product, which may account for the wide variations of the results obtained on this lot.

It is felt that the correction curve obtained as a result of this series of tests is sufficiently accurate for all practical purposes; and the writer has recommended that a table of correction factors based thereon be considered for use in connection with any revision of the present standard rattler test for paving brick. The following addition to paragraph 13 of the standard specifications for paving brick has been suggested:

The result obtained in the original calculation shall be corrected by adding to or subtracting from it a factor depending upon the initial weight of the brick charge in pounds. This factor shall be obtained from the following table:

Original weight of 10 brick	Correction to be applied to percentage of wear obtained by test	Original weight of 10 brick	Correction to be applied to percentage of wear obtained by test
Pounds	Per cent	Pounds	Per cent
105 to 115	0.5+	75 to 79	2.0—
95 to 104	.0	70 to 74	2.5—
90 to 94	.5—	65 to 69	3.0—
85 to 89	1.0—	60 to 64	3.5—
80 to 84	1.5—	55 to 59	4.0—

The final corrected value together with the observed value and the correction factor shall be reported.

Building Highways for Safety

Some paragraphs from a radio address by Prof. S. S. Steinberg, of the University of Maryland

The frequency of highway accidents resulting from traffic congestion has demonstrated not only that we must construct our new highways of ample width, but also that we need to widen many of the roads and bridges now in use. This has led to the construction in the vicinity of large industrial centers and on main thoroughfares of what is known as the "super-highway" to insure the maximum road capacity, speed and safety. It is only by widening our congested roads, and by providing alternate routes, that accidents can be reduced and traffic enabled to move smoothly, quickly, and with a maximum degree of safety. Foremost of the super-highways is the one out of Detroit. This road has a total width of 204 feet, with two separated roadways 44 feet wide, each carrying one-way traffic. On each of the four-track roadways horse-drawn traffic keeps to the right hand curb; slow moving heavy trucks outside them, and automobiles in the two other lanes, thereby providing rapid, safe, and easy movement for all kinds of traffic. In addition, space is provided between the roadways for rapid transit trolley lines, and provision is made for motor parking, as well as for pedestrians. Other highways on which extensive widening programs are going on, or parallel routes are being extended, are the Pacific Highway in the State of Washington; highways out of Chicago; the Lincoln Highway west of Philadelphia; the Boston Post Road between New York and New Haven; as well as roads leading out of Cleveland, Akron and Cincinnati.

One of the developments of the future may be separate roads for freight and for passenger service; a low grade, heavily constructed road for trucks and a less expensive type for passenger vehicles. A road planned primarily for trucking between Boston and New York is now under construction.

To relieve traffic congestion and to promote safety at the intersection of important roads, highway grade separations are now being planned. The first structure of this kind is now being erected just north of Chicago at a very congested highway intersection. The design provides for two levels. Through traffic proceeds on an overhead bridge on one of the roads while turning traffic swings wide of the bridge and uses the ground level.

One of the most recent experimental developments in the interest of public safety is lighting the rural highway at night. The greatest menace of night driving is the abundance of glaring lights which makes driving at such times dangerous. It is found that a large percentage of highway accidents occur at night due to this cause. Lighting the highway not only reduces this danger, but also increases the capacity of the road by making it available for maximum use throughout the 24 hours of the day, and serves as an inducement for trucks to operate at night when passenger traffic is at a minimum. Highway illumination is now in use between Albany and Schenectady, on the Lincoln Highway in Indiana, on the motor causeway out of Miami, and on some roads out of Detroit.

Information Concerning River Flow

The Department of the Interior has recently published a preliminary index to river surveys which have been made by the Geological Survey and other agencies, which has been compiled by B. E. Jones and R. O. Helland as Water Supply Paper No. 558. It lists by states the rivers that have been surveyed, gives a brief description of the maps and states where copies may be obtained. Engineers and others who are studying problems of river flow in connection with water supply, irrigation or for other purposes, will find information of considerable value in these reports. The index may be obtained by applying to the Geological Survey at Washington, D. C.

Dump Body and Grader

A modification of a grader has been made by the State Highway Department of Maine by placing a dump body on a Hadfield-Penfield one-man grader, this body having sufficient capacity to carry the stone needed for patches or small repairs, thus saving the necessity of using an additional truck for this material. The weight of the stone carried is also of assistance in the operation of the grader. The dump body is mounted on the rear of the grader and is easily dumped where wanted. The illustration shows the mounting of the body and the body in dumping position.

DUMP BODY MOUNTED ON GRADER

The Fifth International Road Congress

Principal points of reports adopted at final session of the Congress relative to Concrete and Bituminous Roads, Traffic Census, and Town Planning.

The Fifth International Road Congress was held at Milan, Italy, September 6th-13th. It was attended by about two thousand representatives from fifty countries. Following four days of reading and discussion of papers, at the final sitting of the congress on Friday the various subjects were brought before the meeting and the reports of the committees adopted. At this session Thomas H. MacDonald, one of the United States representatives appointed by President Coolidge, announced that the Secretary of Agriculture had suggested that the next congress be held in the United States, and sought the approval of the Road Congress to this suggestion. The representative of Brazil stated that should the invitation from the United States fail to be adopted by Congress he hoped that the next meeting might be held in the capitol of Brazil. The President of the Permanent Association in Paris stated unofficially that he thought an invitation from the United States would receive favorable consideration.

CONCRETE ROADS

Concrete roads received the first attention of the construction and the maintenance section and there was considerable discussion of the conclusions presented by the general reporter for that section. The conclusion adopted recited that cement concrete roads have proved themselves suitable for use by heavy vehicles on rubber tires, but that no satisfactory system had been evolved for vehicles on metal tires; that the proportion of cement and aggregate must be determined by the thickness of the slabs and the quality of material available; that definite conclusions concerning the technical and economic suitability of metal reinforcement could not be reached without further experiments; the same being true concerning the advisability of transverse and longitudinal joints and also as to the kind and thickness of jointing material to be employed; "the practice of constructing roads with alternating slabs, for the purpose of reducing the dimensions of expansion joints and of diminishing cracks, deserves attention and should be further investigated;" and the same is true of coating roads with hydro-carbon or bituminous mixtures and also of the "silicatisation" of the surfaces of concrete roads with a view to making them harder and securing better preservation; the use of mechanical processes for constructing such roads is advisable from the technical point of view when economic difficulties are not encountered; for repairing damages, quick hardening cements or asphalt concrete are suggested, according to local possibilities and seasonal conditions.

BITUMINOUS ROADS

The report dealing with bituminous and asphaltic roads was much more lengthy and considered the subjects of natural rock asphalt, non-asphaltic, and bituminous materials; covering several of the characteristics of each of these. It was recommended that "a complete study be made of the action of the very fine mineral matter incorporated in bituminous binders, on the so-called asphaltic characteristics of the binding material itself;" also that, in addition to the penetration tests, one for the softening or melting point be included in specifications. Also it was recommended that in addition to a ductility test carried out at 25 degrees Centigrade, there should be other tests made at a lower temperature, say at zero, and at a higher temperature if the test at twenty-five degrees gave an elongation not exceeding fifty centimeters.

"In several countries good results have been obtained by preceding the surface bitumen treatment by a preliminary surface dressing with tar. This method is specially recommended for macadam surfaces composed of friable and dusty materials. Further, in the experience of several countries, the mixing of bitumen with a percentage of suitably prepared tar facilitates bituminous coating." It was stated that the addition of tar to an asphaltic binding material when making asphalt concrete makes it possible to apply the mixture at a lower temperature. A study of these uses of tar was recommended.

In connection with the standardization of tests it was recommended that a committee be appointed for settling a nomenclature for the principal materials and methods employed in connection with road construction, and for standardizing the methods employed in taking samples and making tests; such committee to contain representatives of the languages represented in the congress, also Spanish and a Scandinavian language.

TRAFFIC CENSUS

Several resolutions were adopted in connection with the subject of traffic census. One of these called for reducing all census figures to a twenty-four hour basis by increasing those actually taken during the day sufficiently to provide for night traffic where the census was taken during the day only. Also, that an estimate be made of the yearly average for each section of road, based upon such census as had been taken.

Whatever the classification of vehicles in the various countries it was recommended that they should be grouped as follows:—(a) Animal traction vehicles; (b) Mechanically propelled commercial vehicles, and motor omnibuses with pneumatic tires; (c) Mechanically propelled passenger-carrying vehicles with pneumatic tires (that is, motor cars, not including motor cycles); (d) Mechanically propelled vehicles with solid tires; (e) Motor cycles; (f) Bicycles; (g) Pedestrians; (h) Animals unharnessed or ridden; (i) Hand carts; etc. In each case it is desirable to give the average gross weight attributed to the vehicles of each group; the average width of the

section of road under consideration taking into account the presence of railway lines; the length of the section; nature of the road surface and its state of repair; the weather at the time of the census; and the average useful weight carried by the vehicle unit of each group.

TOWN PLANNING

Perhaps the longest set of conclusions were those drawn by the committee on Development and Planning of Towns in the interest of traffic. These recited at considerable length various features which have an important bearing upon the traffic of cities, including, besides street plans, building regulations; control of the use of land (as in a zoning system); diversion of traffic from the central nucleus, decentralization of offices and industries, and exclusion from busy streets of traffic which does not need to use them; elimination of kiosks, advertisement standards, newspaper stands, etc.; minimizing the parking of vehicles and the passage of slow and cumbersome vehicles through such streets; also, when necessary and possible, the widening of streets and providing of spaces or buildings for parking vehicles, and the construction of lateral arteries alternative to the main traffic thoroughfares, through which the slow and heavy vehicle traffic may pass. Attention was also called to the removal of grade crossings by overhead ways, to traffic signals, one-way traffic streets, and the adoption and enforcing of intelligent and well considered traffic regulations. Concerning subways or subsurface passages, it was stated that pedestrians avoid using these mainly because they are approached by stairs and it was recommended that gently sloping ramps be used instead of stairs and that the subways be provided with attractive shop fronts and other features located along their sides. The removal of surface railways from the heart of the city whereever possible was recommended. Public transport service should carry passengers to points near the center but avoid spots already overburdened with traffic. The resolutions concluded with a hope that steps would be taken to call a diplomatic international conference with a view to securing "uniformity of traffic signals in urban areas by means of signs which can be easily understood without the necessity of reading an inscription."

SPECIAL MOTOR ROADS

Italy was especially interested in the construction of roads reserved for motor traffic, having built one a short time ago from Milan to Laghi, while concessions for similar highways had been granted from the Milan to Bergamo and from Naples to Salerno and others were under contemplation. An extensive set of conclusions was proposed by the Italian representative beginning with the statement:—"The creation of roads reserved for the use of motor traffic may be considered as justified when the mixed traffic on the ordinary highways in the neighborhood of, or between, densely populated centers or passing through places which have a busy, industrial, commercial or pleasure traffic, leads to a saturation and a deadlock dangerous to the circulation and contrary to transport economy. Also when the absolute preponderance of motor traffic of every kind (passenger, goods, fast and slow units) render it necessary to ensure for it the highest possible return in the form of speed, nonstop running and safety."

The American and English representatives could not agree to this statement, the American probably having in mind the fact that practically every road in the United States is already confined largely to motor traffic, there being little of any other kind in this country, and they refrained from voting. As contemplated, such a road would be fenced off from the surrounding country and would pass under or over every other highway or railroad so that there would be no delay of vehicles in transit from one main terminus to another.

European Road Ideas

Selections from the General Reporters' summing up of papers before the Fifth International Road Congress.

CONCRETE ROADS

"With a view to reducing the dimensions of the joints to a minimum, concrete pavings have been proposed and carried out with very short or with alternating slabs. According to the Belgian report, this latter method has notably diminished cracking, as the odd slabs originally made have already undergone contraction due to the setting of the concrete when the laying of the even slabs is proceeded with. According to the English report, no special advantages have resulted from the adoption of such a system as compared with that of continuous slabs. It is obvious that in the results obtained the length of the individual slabs, and the conditions of the foundation and those under which the seasoning was effected, all factors of too varying a character to allow of establishing a constant rule, played a part. On the other hand, the method of laying by alternate slabs cannot but complicate the working process.

"The method of repairing concrete roads varies very considerably according to the extent of the damage to be repaired. When the damage done is of a very slight character, mere hand chiselling may suffice; but when the damage is greater, pneumatic drills and pneumatic rammers for filling in will be necessary. For repairs right down in the body, the English report recommends the use of quick-setting cements, and for surface repairs the use of asphalt concrete 5 to 7 centimetres thick, the advantage being that traffic can be allowed to pass over sooner. The adoption of liquid cement, the use of which has spread of late, allows of obtaining a strength of 250 kg. per sq. cm. after eight hours' use.

BITUMINOUS ROADS

"While the penetration test is so far not only in general use, but also in many cases the only practical method of ascertaining the value of a

bituminous material, there is now a tendency to consider that the value of this test has so far been over-estimated. It is admitted that the constancy of the penetration figure may be of value for ascertaining the constancy of a type of bituminous material, when the original raw material remains constant as well as the method of penetration, but this guarantee disappears when there is a change in the raw material or the method of penetration, as the penetration may be the same for materials substantially different and behaving differently under the action of traffic and climate. Another test, the utility of which is now being discussed (or, at least, its correct interpretation), is that for ductility. The necessity is generally recognized for a bituminous binding material to preserve, even at a low temperature, a certain ductility, in order that a bituminous road may not become brittle; but, at the same time, it is demanded that the same road shall not become too soft during the warmest season. Some reports even express the opinion that there is no great harm done if some capillary fissures should form during the winter, provided that the bituminous paste retained the property of binding again during the warm season, or, in other words, provided that the bitumen had not lost its cohesive qualities. The criticism which is opposed to the present method of making the test for ductility, is particularly directed against the fixed temperature of 77 deg. F., or 25 deg. C., a temperature which does not correspond with that of the maximum ductility of a bitumen, except in special cases. The most important thing now would be to know precisely at what temperature this maximum ductility occurs, and how this decreases with reduced temperatures.

"It is recommended that there be used 'the test for temperature of melting (by the ball and ring method, which appears to be the most general and most perfected one) side by side with the penetration test, which will always remain the fundamental test, in spite of the reservation attaching to it.'

"As regards the ductility test, if it is desired to continue it, it will be necessary not only to carry it out at the traditional temperature of 77° F, but also at a low temperature, say at the temperature of melting ice, and also at a relatively high temperature. Of course, this refers to a bituminous material of low ductility at 25° C, and which would give an elongation of less than 50 cm. At that temperature we should then have a sufficiently complete table of the behavior of the bituminous material from this point of view.

"As to the stability of a bitumen we may take it that the general test is that of comparing the penetration in the original material and in its residue after heating during five hours at 325° F (163° C.), or any higher temperature in special cases."

Day Labor Construction in South Africa

Opinions of the town engineer of a South African town as stated in a paper before the Municipal and County Engineers. Believes principle of day labor work is sound, but must contend against difficulties.

Discussion of the advantages and disadvantages of building public works by day labor rather than by contract is not confined to the United States, but is also to be found among the public officials in South Africa.

At a recent African District meeting of the Institution of Municipal and County Engineers held at Port Elizabeth, George Begg, town engineer of Brakpan, South Africa, discussed the subject at considerable length, endeavoring to give the arguments on both sides impartially. In his introduction he said:

There can be no logical reason why departmental work [day labor] should not be a success, and if it is sometimes unsatisfactory and often more costly than contract work, the principle of departmental work cannot possibly be to blame. In all probability the apparent failure of departmental work will be due to one or other of the following causes, or to a combination of them.

(1) Inefficiency of the town engineer.
(2) Interference in carrying out municipal work.
(3) Inefficient and redundant employees.
(4) Undue attention to the grievances of disgruntled employees.
(5) Municipal regulations under local government ordinances.
(6) Privileges granted to employees.
(7) Failure to keep accurate cost analysis of work.

Mr. Begg then enlarged on each of these seven points. Concerning the second he said: "There is not greater cause of failure in departmental work than this."

He finally sums up the subject as follows:

It is very obvious that departmental work has to contend with many difficulties before it can be a success, but those difficulties are not insurmountable if some attempt would only be made to understand them thoroughly. Such an attempt is seldom made, and departmental work is usually blamed if an estimate is exceeded. The real cause of the extra cost is never due to the principle of departmental work.

In contract work, however, all these difficulties are aovided and perhaps this is the reason why contract work is so much in favor. The adoption of contract work certainly makes it easier from the municipality's point of view, and the engineer is saved a lot of worry and trouble by shifting on to the shoulders of the contractor the responsibility for the organization of the work to be carried out. But contract work is not to be commended for this reason, and even though the contractor is usually regarded as an expert in his work, there is no reason why the town engineer should not be sufficiently expert also, and if he can be responsible for the preparation of plans, specifications and conditions of contract, and can see that the contractor works according to them, he surely should be competent to carry out the work himself under the conditions which he himself has

drawn up. The fact that this is not always the case is not the fault of departmental work.

In contract work the cost is more or less known beforehand, as the contractor stipulates to carry out certain work at a definite cost, and the advocates of contract work argue that the great advantage of this lies in the fact that any loss on the work is borne by the contractor and not by the municipality. But it is not very satisfactory to contemplate, particularly from a municipal point of view, that any of the municipal works, built for the benefit of the community, should result in a loss to anyone. The contractor, however, has not built up his business on losses but on profits, and those who favor contract work because the contractor and not the municipality runs the risk of losing, should not forget that the contractor may only be able to run this risk on account of the profits made on previous contracts.

Departmental work, if carried out properly, will be completed at the proper cost, and if this is not the case the remedy is not the adoption of contract work.

The one real argument in favor of contract work might be applied in the case of a scheme where the purchase of a considerable amount of plant would be necessary. Such a scheme would be a complete departure from the usual work of a municipality, and would require plant which would never be of any use again and would require to be sold off on the completion of the work.

In a case of this description contract work would perhaps be cheaper, as the contractor with suitable plant might have written off this plant on previous schemes, and thus be able to neglect the cost of it in making out his contract prices. But even then it should not be forgotten that the possibility of writing off this plant was perhaps only due to the profits on other schemes and the scheme on hand would only benefit for this reason.

Mr. Begg concluded his paper with an account of actual experience of contract and departmental work in Brakpan municipality, which, he suggested, amply proved his contention that the principle of departmental work is not at fault.

Some will not agree with his statement that "There is no reason why the town engineer should not be sufficiently expert also (as compared with a contractor), and if he can be responsible for the preparation of plans, specifications and conditions of contract, and can see that the contractor works according to them, he surely should be competent to carry out the work himself under the conditions which he himself has drawn up." It by no means follows that an engineer who is excellent at designing and planning work will be equally successful in the practical details involved in constructing it.

Super-Highway Contest

Cash prizes totaling $1,500 are being offered for the best ideas with reference to the construction, beauty, economy and efficiency of a road 200 feet wide to serve as a super-highway for connecting Cooke, DuPage and Kane Counties, the idea being to bring out the most practical and original plans for such construction. Plans will be received up to 5:00 o'clock on the 15th of next December. A first prize of $1,000 is offered, a second of $300 and a third of $200. Jointly with DuPage County, the Metropolitan Super-Highway Association is acting in the matter. This association, composed of citizens of the three counties named who are desirous of furthering the interests of super-highways in the metropolitan area around Chicago, has prepared a booklet with the idea in mind of assisting contestants to a better understanding of the general plan for these super-highways, and a copy of this book and the rules of the contest will be sent to any one interested by addressing the association at Room 503, Burnham Bldg., 160 North La Salle Street, Chicago.

Expediting the Setting of Concrete

The adoption of methods whereby it was possible to open to traffic in three days a concrete pavement which would ordinarly be closed for two or three weeks is described in the *"American Contractor"* by G. W. Thatcher, vice president of the Standard Paving Company of Chicago. The work consisted in changing the grades at three intersections on Ogden Avenue near La Grange Park to make connections with three streets which were being opened up. The work required tearing up only one-half of the width of the street, so that traffic was not entirely interrupted at any time, but as approximately one thousand automobiles an hour use the street during the busy hours, even the half obstruction was a serious inconvenience.

Mr. Thatcher states that his company finished placing the concrete late Tuesday afternoon and it was open to traffic Friday night. An inspection made the following Monday, after a week-end traffic during which at least 25,000 trucks and pleasure vehicles had passed over it, showed it to be in first class condition. When five hours old it was sufficiently solid to permit walking on it without marring the surface in any way. Sprinkling of the pavement was begun when it was six hours old. Tests made on the job by Robert W. Hunt Company showed a compressive strength per square inch at three days of 2,364 pounds, at seven days of 3,600 pounds, and at twenty-eight days of 5,248 pounds.

This high early strength was produced by a decrease in the amount of mixing water, increasing the mixing time, using more cement, and keeping the pavement damp until it was put into service. The mixture used was 1: 1½: 2½ with between 4½ and 5 gallons of water per sack of cement. A good grade of sand was used, and crushed limestone for coarse aggregate. Hoppers on Barber-Greene loaders were set for 7½ feet of sand and 12½ feet of crushed stone, with which was mixed 5 sacks of cement. The concrete was mixed for two minutes. This did not proportionately increase the cost and decrease the output as compared with one minute mixing, as it allowed every one adequate time to do his work, reduced idle time of the mixer, and required fewer men and trucks for handling the material.

The three intersections contained a total of 185 square yards of pavement seven inches thick. In mixing this, 322 sacks of cement were used, which gives 2.2 barrels to a cubic yard of concrete as compared to 1.7 barrels for the standard 1: 2: 3: mix.

or two additional sacks of cement per cubic yard. The construction was supervised by Edwin Hancock, village engineer of La Grange Park, and J. H. Chubb, manager of the Service Bureau of the Universal Portland Cement Company, which furnished the cement for the work and whose recommendations for expediting the setting had been followed.

Dynamiting a Drainage Canal

The city of Sebring, Fla., is located on Lake Jackson and a short time ago decided to build a boulevard around the lake, first permanently lowering the level of the lake. To effect this lowering a contract was let last spring for constructing a canal to carry surplus water toward Lake Josephine. The contract called for a canal 3,000 ft. long, 22 ft. wide at the top, 10 ft. wide at the bottom and 3½ ft. deep. The line of the canal ran through a dense growth of bay trees, water oaks, cypress and underbrush and crossed a small stream three times. The soil was heavy black muck of varying density from 2 to 6 ft. deep, underlaid with white sand and thoroughly saturated with water. The contract was let to Baird and Schriber of Lakeland.

In constructing the canal the trees and the brush were cut down along the right-of-way and the logs moved to one side but the stumps left. The removal of the soil was done by use of dynamite, 50 per cent Dupont straight dynamite being used. The holes were punched in three rows, 3 ft. between rows, the holes in each row being 24 to 28 in. apart. Two cartridges were placed in each hole in the center row and from 1½ to 2 cartridges in each hole in the side rows, depending upon soil conditions. Small extra charges were placed on one side of each of the larger stumps in order to throw them out of the way and not a single stump fell back into the ditch. In all, 45,000 lbs. of dynamite and 100 electric detonators were used.

Shooting was done by the propagation method, detonators being placed in only 3 or 4 holes in each row of 500 ft. stretch, the shock from the explosion of these setting off the adjoined charges. About 500 ft. were loaded and fired each day. Blasting as described above produced a ditch 14 ft. wide at the bottom, 22 ft. at the top and 3½ ft. deep and scattered the excavating material so widely that practically no spoil banks were left to interfere with the surface drainage. One day was spent in cutting off the protruding roots and clearing out those that fell back into the water, but no shovel or piece of machinery of any kind was used in the center line of the canal. Within seven days after the work was started the canal was completed and accepted by the city.

Philadelphia-Atlantic City Toll Road Proposed

It is said that a company is being formed to build a highway between Philadelphia and Atlantic City in which there will be six traffic lanes, the outside one for trucks, the next for vehicles making moderate speed, while on the center drives machines could travel as fast as they desired. This would be a toll road and toll for the sixty-mile run is tentatively suggested as $1.00 per vehicle. The promoters think it probable that many automobilists would prefer to pay this for the use of a private thoroughfare in preference to crowded public highways. It is expected that either bridges or tunnels will be used for eliminating grade crossings at all roads and railroads, connections being afforded with the main arteries crossed, however.

Roadside Water in Connecticut

The State Department of Health of Connecticut, following the precedent set by several other states, has this year begun an investigation of the wells, springs and other supplies of drinking water found along the highways of the state with a view to preventing the use by travelers of any which is unsafe.

The bureau learns the locations of supplies used by the traveling public in their respective districts from the highway supervisors of the state highway department. An inspector then visits each supply, collects a sample and examines the source of the supply. By means of a brush and can of paint which he carries with him, he marks on or near the supply the individual number of the sample taken, each sample being given both the number of the highway and it individual number in the series for that highway. Examination of the source of supply may indicate that it should be classed as unsafe. All open or running streams are so classified. Chemical and bacteriological analyses are made of the

RIGHT OF WAY OF CANAL CLEARED

SEBRING CANAL COMPLETED

Where a supply is found to be unsafe or questionable, the highway department is so advised and requested either to make necessary constructional changes or else make the supply unavailable, as by removal of the pipe, pump, etc. If the point of availability of the supply is on private land, the private owner is requested to make the necessary change, if possible, or to do away with the supply. In case this is not possible, the supply is posted as "unsafe."

Where a supply is found to be safe, it is posted by the state highway department. For posting the safe supplies the highway department has made wooden signs painted with black letters on white background with the legend "Drinking Water". On the right hand lower corner is the inscription, "State Dept of Health", and on the left hand lower corner is blocked out a four-inch square, onto which is tacked a card furnished by the State Health Department, a different color of card being used each year. The 1926 card is blue, of heavy cardboard. On this is printed "This water was analyzed on..... 192.... and found safe for drinking purposes", the date being filled in with black ink and the number of the sample marked on the bottom of the card. On the back of the card the Health Department writes the location to which it applies and the card is then turned over to the Highway Department to be placed upon the sign. The cardboard used is believed to be a material which will last throughout the season but which would not last much more than a year, thus requiring new cards based upon a new analysis to be placed on the sign each year.

Extension of Toronto Water Works

A report on the proposed extension to the waterworks system of the city of Toronto has been made by William Gore and H. G. Acres as consulting engineers, which is said to be in harmony with the basic principles of the report made in 1913 by the Commissioner of Works. The chief aim was the provision of a safe and abundant supply and the elimination, as far as possible, of all risks of discontinuity of service.

The engineers considered five sources of supply, namely Lake Simcoe and four points on the shore of Lake Ontario. Preference was expressed for taking Lake Ontario water at Victoria Park, near the eastern city limits.

In examining the water at the various suggested points of supply, that at Victoria Park was found to be of lower bacterial quality than at other points, but because of its greater physical purity it could be purified more simply and economically, and it would be necessary to purify the water from any of the proposed sources.

The main features of the scheme proposed include an intake tunnel 10 feet in diameter and extending 3300 feet into the lake, where the depth is 30 feet; which tunnel would have a capacity of about 300,000,000 gallons per day. Second, three steel intake pipes from the tunnel shaft, only one of which will be constructed at present, which will be 8 feet in diameter and 4,250 feet long, terminating in fifty feet of water and having a capacity of 125,000,000 gallons per day. Third, law-lift and high-lift pumping stations, coagulation basin filters, reservoir, offices and laboratory at the intake pipe, these being based on a capacity of 100,000,000 gallons per day, with provision for doubling capacity in the future. Four, a concrete-lined tunnel to the present main pumping station and a second tunnel from this to a new pumping station in the western section of the city. Five, a 50,000,000 clear water reservoir in the northern part of the city. Six, additions to the distribution system. The net total cost of the work is estimated at $14,317,000.

New York's Sewage Problem

Pollution of waters, as measured by dissolved oxygen content, in harbor and rivers increasing and nuisance imminent at several points. General treatment necessary.

The English Parliament building is located on the bank of the Thames river and possibly this location had much to do with the early progress made by the English in treating sewage, for it is stated that the pollution of the Thames river, due to the sewage discharged into it from London, finally resulted in such an unbearable stench that it was impossible for Parliament to meet until some relief was effected.

Possibly if the New York State Legislature met on the bank of the Harlem or East river in New York City, more prompt action toward treating the sewage of New York might be taken. For several years the Board of Estimate and Apportionment of that city has been petitioning the legislature to turn back to the city a portion of Wards Island to be used for a sewage treatment plant, this being the best and almost the only area available for this purpose, one which originally belonged to the city, and which is not now being put to any useful purpose.

Engineers have for years been warning the Board and the citizens that unless something is done very soon, the waters around New York City will reach the condition where they will occasionally, if not continuously, be a nuisance if they do not indeed threaten the health of the community. In a report dated September 7th to Arthur B. Tuttle, chief engineer of the Board of Estimate and Apportionment, Kenneth Allen, sanitary engineer to the Board, presented recent figures of analyses of these waters for dissolved oxygen, which is taken as a measure of that condition of the water which is apt to result in a nuisance. A few years ago, the percentage of satuation of dissolved oxygen in the water that was essential to maintaining fish life therein was considered of interest and referred to by engineers, but this has for several years been entirely disregarded for it was generally assumed that about fifty per cent saturation was required

for major fish life, whereas for several years past there has been no part of the harbor or waters around New York City which even approximated 50 per cent saturation of dissolved oxygen. In 1925, complete absence of dissolved oxygen was found at two points in the Harlem river, while in the East river less than 10 per cent of saturation was found at four points. In August of this year, zero saturation was reached at 23rd Street in the East river and at all points in the Harlem river; while less than 10 per cent of saturation was found at two other points in the East river and at all points along the Hudson river.

Mr. Allen states that the Narrows reflects better than any other station the resultant pollution of all the water of the inner harbor. In 1914, the dissolved oxygen at the Narrows reached a minimum of 45 per cent, in 1925 it reached a minimum of 34 per cent, while on August 4th of this year it reach 14 per cent. This was the highest minimum percentage found at any point in the waters around New York City in August of this year except at Throgs Neck, where 40 per cent was found, probably due to the effect of comparatively unpolluted salt water reaching this point from Long Island Sound.

One interesting point brought out by Mr. Allen is that "At Robbins Reef, near the Passaic Valley Sewer Outlet, the effect of the discharge was not yet as evident as might be expected, for although the degree of saturation was very low—12 per cent—it was lower still in a sample tested in 1921 before a discharge took place." As the Passaic Valley sewer is now discharging at this point the sewage from practically all the communities in the valley, except a part of the manufacturing wastes, it would appear that the means employed for distributing the sewage broadly over a considerable area and at great depth has resulted, as was planned, in rapid dilution and a minimum of nuisance created.

Mr. Allen states that moderate temperature and low rain fall in June and July followed by high temperature in August combined to lessen the dilution of polluting material while increasing its avidity for oxygen, the result of which was a series of very low minimum saturations. This unfavorable condition may not, of course, be repeated next year or for several years; on the other hand, it may be exceeded next year or within a very few years, in fact is very likely to be. In 1921 conditions were even more unfavorable, and many of the minimum saturations of that year almost equaled, and in two or three locations did equal, the minimum obtained in August of this year.

Concluding his report, Mr. Allen says: "While their condition (that of the Harlem and Lower East rivers) is of the most serious moment yet more impressive is the reduction in minimum saturation observed during the past few years in the Hudson and Upper East rivers and Upper Bay, which is made clearly evident by the general trend of the results already given. With the high saturation prevalent fifteen years ago in these waters, such a lowering exceeds all anticipation and with the rapid increase of population there is no reason to look for any permanent improvement until the question of sewage disposal is taken in hand on a larger scale than heretofore. Fine screening, to which improvements to date have been generally limited, serves a valuable purpose in improving local conditions, but has little bearing on the general pollution of the harbor. To bring about any material improvement, the least that is necessary will be to treat large volumes of sewage—say 100,000,000 gallons per day or more—by settling out the solids in tanks. The cost of collecting the sewage and of the plant itself means the expenditure of large sums of money, but there is no way to evade the matter if any material benefit to the harbor as a whole is to be expected."

Anaerobic Decomposition of Sludge

Study of methane gas formation in Imhoff tanks made in a Russian Laboratory, and conclusions therefrom

Experiments were conducted at the Moscow laboratory from 1918 to 1921 to determine the practicability of utilizing the methane gases which are developed in the Imhoff tank. These were described by K. N. Korolkoff in a report which is abstracted as follows in the October 16th number of "Public Health Engineering Astracts."

The two methods of sewage treatment are the normal alkaline and the abnormal acid method. Thumm and Reichle accept the acid fermentation as the normal process. According to their views the fatty acids are neutralized by the alkaline of the supernatant liquids and by the sludge itself. The ripened sludge plays no part in the process. According to Imhoff's observations, the micro-organisms in the decayed sludge play an important part. We accept the necessity of the micro-organisms but the micro-organisms which decompose the fatty acids no doubt play the most important part. This biological process is the most important difference between the two processes of decomposition. In the normal alkaline process the fatty acids are decomposed into CH_4 and CO_2. In the abnormal acid fermentation the fatty acids accumulate and all other fermentations are retarded by the concentration of acid-forming bacteria.

Our experiments have proven the necessity of high buffering solution and of a narrow range in the hydrogen-ion concentration. A pH of about 7.8 seems to be the most favorable for the development of these organisms.

Thumm's recommendation to neutralize the high acidity with lime proves the necessity of a high concentration and the buffering of the

supernatant liquids. Upon the addition of lime, contrary to Imhoff's view, very satisfactory results are achieved.

The bacteria which liquefy the solid particles of the sludge play an important part. Variations in temperature affect the intensity of the process in a very high degree. When the microflora, the mixing of the sludge, and the proper temperature are established, the process continues normally in a decomposition chamber. In the normal fermentation process no acid accumulation takes place. The abnormal fermentation yields from 100 to 320 millaequivalents and in the normal fermentation all the fatty acids are gradually decomposed; the CO_2 combines with the alkalies to form bicarbonates. Their presence constitutes the buffering of the supernatant liquid.

The three factors which affect the reaction of the supernatant liquids are the following: the rapidity of the acid formation, the rapidity of the acid decomposition and the buffering capacity of the supernatant liquids. The undesirable foaming of the sludge tanks is due to the presence of large quantities of bicarbonates coming in contact with the great quantities of fatty acids which have accumulated. The intensity of decomposition is inversely proportional to the amount of fresh sludge. The volume of gas increases with the increase of fresh sludge. The intensity of the gas formation depends upon the relationship of the fresh and decayed sludge, the micro-flora and the buffering of the supernatant liquid.

Because of serious obstacles we could not determine the effect of temperature variations, although we realize that they play a very important part in the economic operation of a sewage disposal plant. The low ash content of our sludge is noteworthy when compared with Spillner's and Hommon's data.

The normal alkaline fermentation yields a sludge which is the result of definite biochemical decomposition. The chemical character of this process is affected by three factors; the mixing of the fermenting materials, the biological and physiological characteristics of the microflora decomposing the sludge, and the high buffering action of the supernatant liquid and its pH value of about 7.8.

Our results compare in a satisfactory manner with the results of other authors. The character of the gas formation agrees quantitatively and qualitatively with what has been achieved in other countries. Further experiments upon that phase of decomposition which we could not carry out, namely, the effect of temperature, are important and necessary.

Experimental Studies of Water Purification

A preliminary review of work completed and in progress by the United States Public Health Service. Abstract of a paper before the American Water Works Association by H. W. Streeter, sanitary engineer, U. S. Public Health Service, and one by Frederic J. Moss, assistant sanitary engineer, U. S. P.H.S., in Public Health Reports.

Beginning in October 1924, the U. S. Public Health Service has been making an experimental study of the efficiency of current purification processes in relation to the various conditions of raw water pollution such as are found along many of our sewage-polluted streams which serve as sources of purified municipal water supplies. For the purpose of making this study, the Public Health Service in 1924 constructed at Cincinnati a small but fully equipped rapid sand filter plant of modern design. The main supply of raw water for the plant is taken from the Ohio river, but facilities are provided for adding to the river water continuous supplies of either domestic sewage or clear dilution water in any desired proportion, thereby making it possible to vary at will, and over a wide range, the physical and bacterial character of the raw water.

The primary objective of the experimental study has been to check, under conditions subject to experimental control, the results of a collective survey of a group of 17 municipal filtration plants made in 1923 and 1924, the major purpose of which was to determine the maximum limits of raw water pollution which are consistent with the production, by the average well-designed and operated modern plant, of effluents meeting given standards of bacterial quality.

The plant contained several unusual features, but in general is believed to serve as an example of the possibilities which exist for constructing highly efficient water purification plants for small communities of less than 2,000 inhabitants. This plant has a capacity of treating about 160,000 gallons per day, or a community of 1,600 people at a rate of 100 gallons per capita daily.

DESCRIPTION OF EXPERIMENTAL PLANT

The intake in the Ohio river consists of a 4-inch steel screw-joint pipe about 150 feet long, 30 feet of which is below the normal pool level of the river, and the upper end of which is

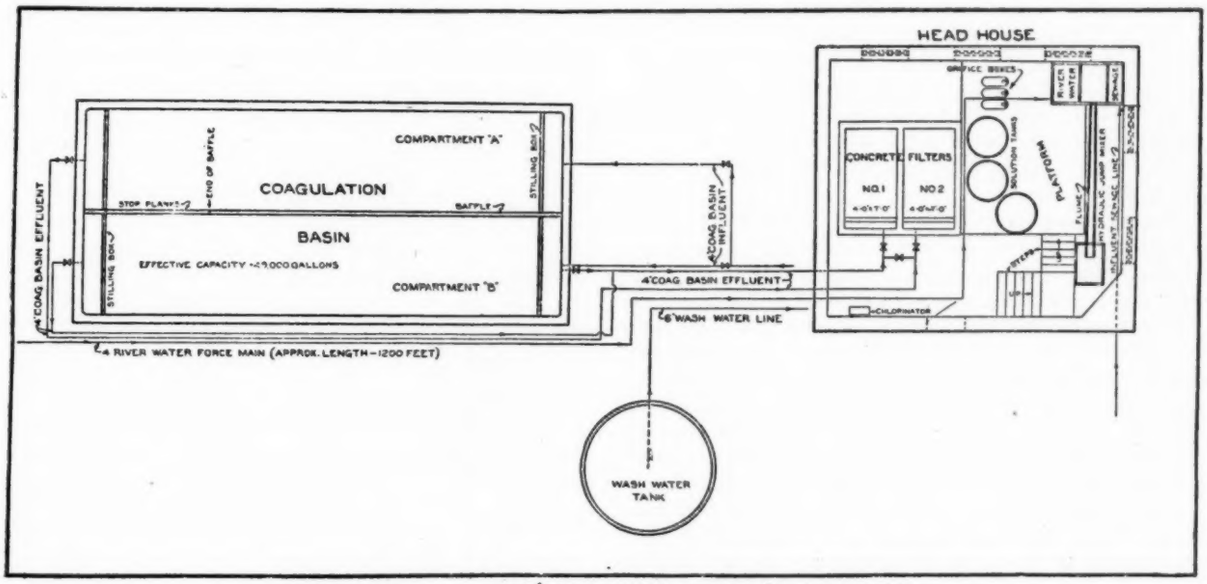
connected to the force main at an elevation corresponding to a river stage of about 60. There is a foot valve at the bottom of this pipe and eight 4x3-inch tees are located at 15-foot intervals, each carrying an outstanding hose valve, and seven gate valves are inserted in the 4-inch line midway between these tees. By this arrangement the pump, which is mounted on a traveling carriage which is moved up and down the bank as the river rises or falls, can have its suction connected to one hose valve and the discharge to the next hose valve; when, the gate between these two having been closed, the intake pipe serves as a suction pipe below the valve and as a discharge pipe above it. The pumping unit consists of a two-stage centrifugal pump with a 3-inch suction and 2½-inch discharge, directly connected to a 15-horsepower induction motor with a capacity of 175 gallons per minute against 150 feet head. The car on which this is mounted travels up and down the river bank on a narrow-gauge industrial track, parallel to and about a foot from the intake pipe.

The sewage used for deliberately polluting the water is domestic sewage from a residential section of the city obtained from an intercepting sewer near the plant by gravity flow through a 1½-inch pipe to the basement of the plant, whence it is pumped to the mixing device either directly or after flowing into an equalizing tank. For mixing device the hydraulic jump type is used.

The receiving tank is divided into three compartments, one of which receives river water, another sewage or clear dilution water, while these flow into a central compartment over 90 degree V-notched weirs, which permit mixing the two fluids in any desired proportion. From the middle compartment the mixed fluid flows down an inclined flume which has a drop of three feet in ten, in which the water obtains a velocity of about 9 feet per second at the bottom. A submerged weir set in the horizontal portion of the flume builds up a standing wave or hydraulic jump, in which the components forming the river water become mixed. From the lower tank of the mixer the water flows by gravity to a coagulation basin.

The coagulation basin is 37 feet long, 16 feet wide, and 11 feet 6 inches deep, inside dimensions. It is constructed of reinforced concrete, with a wooden longitudinal baffle extending through the middle of the tank and wooden stilling boxes at each end. The longitudinal baffle extends to within 9 feet 8 inches of the far end of the basin, leaving a clear space 8 feet wide between the end of the baffle and the stilling box for flow around the end of the baffle. Provision is made for closing this 8-foot space by means of stop planks, thereby dividing the basin into two separate compartments. The normal capacity of the basin is 45,000 gallons, providing a nominal detention period of slightly more than six hours. When the plant is operated at half its normal capacity, only one of the filter units being in service, the stop planks are put in position and one half of the coagulation basin is used. If desired, the entire basin may be used as one filter unit, giving a nominal detention period of approximately 12 hours. Influent and effluent connections are arranged so that the two compartments of the basin may be operated either in series or in parallel.

There are two rapid sand filter units of reinforced concrete, each one providing a net filtering area equal to 4x7 feet. The normal rate of filtration is 2 gallons per square foot per minute. The filter sand is washed Ohio river sand, 27 inches deep with effective size of 0.42 m. m., and a uniformity coefficient of 1.50. Underlying the sand is a 14-inch layer of gravel graded in size from 1¼ inches at the bottom to less than ¼-inch at the top. The underdrain system is of perforated pipes, 4½-inch manifold and 1½-inch



GENERAL PLAN OF EXPERIMENTAL FILTRATION PLANT

laterals. The laterals are spaced 6 inches apart on centers and are drilled with 9-32-inch holes staggered every six inches along the under side in two lines 45 degrees from the vertical diameter. Semicircular wash water gutters are so placed as to permit high-velocity washing up to an equivalent of 25 inches vertical rise per minute. Simplex rate controllers capable of being adjusted to carry rates of flow varying from 50 to 120 gallons per minute, are provided on each of the filter effluent lines. Direct-reading glass-tube guages are used for registering the loss of head, one tube being connected to a pipe through the filter wall just above the sand layer and the other to the filter effluent line just ahead of the rate controllers.

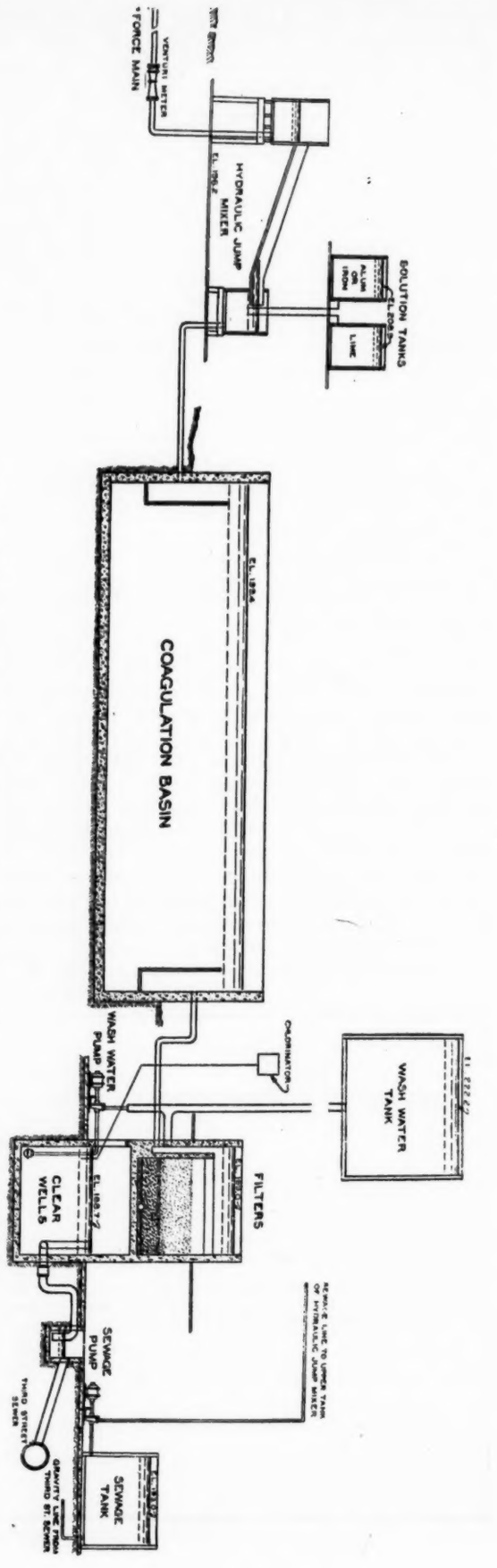
Under each filter is a clear-water well 5 feet deep, providing a detention period of about 20 minutes at normal rate of operation. The effluent from either or from both filters can be discharged into either clear-water well. The flow from these wells is registered by an integrating water meter of the detector type. The effluent line discharges into a sump overflowing into a sewer.

A chlorinator of the manually controlled, solution feed type, permits applying chlorine to the filtered water at its entrance to the clear-water wells or to the coagulated and settled water immediately prior to filtration, or to the raw water just before its entrance into the sedimentation basin.

Wash water is stored in an elevated wooden tank 10 feet diameter and 8 feet 6 inches deep with a storage capacity of about 4,800 gallons. Water is pumped to this tank from the filtered-water reservoirs by means of a single-stage centrifugal pump, direct connected to a 3 horse power induction motor, this unit having a capacity of 60 gallons per minute against a head of 45 feet.

Three small wooden tanks, each 3 feet in diameter and 4 feet deep of 200 gallons capacity, are used for preparing and storing solutions of alum, iron sulphate and lime. The lime tank is equipped with a mechanical agitator consisting of a vertical rotating shaft carrying two vanes inclined at an angle of 30 degrees with the horizontal, operated by a one-third horse power electric motor.

Three cast-iron porcelain-line orifice boxes are used for measuring the chemical solutions. These boxes are provided with float-regulated inlet valves adjusted to maintain a constant level of solution in the box for any given rate of flow. Each box also is equipped with an adjustable slotted orifice with tight jointed sliding cover plate actuated by an adjustable spindle and graduated head. All bends in the chemical piping are made of tees with their open ends screw plugged and provision is made for a flushing-water connection on each one of the distributing lines. The chemicals are usually applied to the raw water at the end of the flume in the lower tank of the hydraulic jump mixer. However, provision is made for adding coagulant solutions



DIAGRAMMATIC PROFILE OF EXPERIMENTAL FILTRATION PLANT

to the water at the mid-point of its travel through the coagulating basin and also as it leaves this basin.

In conducting the experiment, the plant has been operated as nearly as possible in accordance with the methods which are common to a majority of full-scale plants. It has been operated continuously throughout the entire 24 hours for 6 days a week, and every effort has been made to produce an effluent comparable from a physical standpoint with the effluent delivered by large municipal plants. In general, the observations are divided into a series of weekly "runs," during each of which the bacterial pollution of the raw water has been varied progressively, ordinarily once in each twenty-four hours, over a predetermined range, with all other conditions held constant throughout a given run. The results of the observations have been averaged by 24-hour periods rather than considered individually.

CONCLUSIONS FROM THE EXPERIMENTS

The results of the experiments indicated that under similar conditions with respect to the density and character of raw water pollution, the efficiency of bacterial purification shown by the experimental plant corresponds very closely to that of full-scale plants of the same type for which data are at hand. Comparison of experimental results with those obtained at five Ohio river plants have indicated that the results of observations made at the experimental plant may be applied without any material qualifications to the conditions of full-scale plants of the same type and degree of elaboration. This indication is considered as being one of basic importance in relation to the conclusions to be drawn from the experimental study.

The results of the study have confirmed both the existence and nature of a relationship previously observed as between the bacterial quality of the raw water as delivered to the plant and the effluents produced at the various successive stages of treatment. This relationship has been found to be governed by an apparently basic law which may be expressed mathematically by the equation $E=c\ R^n$, in which, R denotes the bacterial content of the raw water, E the resulting bacterial content of the effluent, and c and n are empirical constants which vary with the type of purification process, the kind of bacteria, and the number of intermediate stages of treatment between the source of raw water and the particular effluent considered.

It is indicated, for example, that the maximum B. coli index of the raw water consistent with the production of chlorinated filter effluents conforming to the revised Treasury Department standard is approximately 5,000 per 100 cubic centimeters, and the corresponding maximum derived from the experimental study has approximated 6,000 per 100 cubic centimeters. Making due allowance for observational errors and other sources of expected divergence in these figures, their mutual agreement may be regarded as being very reasonably close. As regards the production of unchlorinated effluents conforming to the revised Treasury Department standard, the survey has indicated the permissible raw water maximum to be approximately 60 B. coli per 100 cubic centimeters, the experimental studies to be 100 per 100 cubic centimeters. These two figures likewise may be considered as being substantially in agreement with each other.

These studies have also indicated an influence exerted on the efficiency of bacterial removal in certain factors which are not subject to control by the operator, notably by variations in raw water turbidity and by periodic changes in seasonal conditions. Observations so far indicate:

"1. That the over-all efficiency of bacterial removal, as measured in terms of the 37°C. plate count, is influenced decidedly by both factors, but the corresponding over-all efficiency of removal of organisms of the B. coli group appears to be affected only to a minor, if any, extent by either factor.

"2. That the efficiency of removal both of plate-growing bacteria and of B. coli by preliminary coagulation and sedimentation combined is influenced to a measurable extent by variations in raw water turbidity, this effort being virtually offset, however, as regards the removal of B. coli, by the tendency of filtration and chlorination to equalize whatever difference in the efficiency of the preliminary stages of treatment may be caused by these turbidity variations.

"3. In general, the over-all efficiency of bacterial removal and, more especially, of B. coli removal, is affected to a considerably greater extent by variations in the density of bacteria in the raw water than by turbidity or seasonal changes. This statement does not apply necessarily, however, to the efficiencies of separate stages of the treatment process, notably to those of filtration and chlorination, which either tend to remain practically constant or show no orderly relationship to changes in any of the three variables named.

"The practical significance of these observations lies in their indication that as far as the more important group of bacteria are concerned, namely those of the B. coli group, neither variations in raw water turbidity nor the changes associated with seasonal rotations appear to have any decided influence on the over-all efficiency of bacterial removal. The only separate stage of the purification process which seems, in fact, to be affected in this respect by variations in turbidity, in season, or in the density of raw water bacteria, is that of preliminary coagulation and sendimentation combined, the bacterial efficiency of which is influenced to a measured degree by variations in raw water turbidity and to an even greater extent by changes in the density of raw water bacteria. With this exception, the efficiency of water purification processes in respect to bacterial removal appears to be a fairly stabilized phenomenon, relatively uninfluenced by any of the major factors which are not subject to control by the plant operator."

At the time this paper was written, a second-

ary series of experiments were in progress with a view to studying the influence exerted on the efficiency of bacterial removal by those factors which can be controlled, at least in part, by the plant operator. Separate study will be made of preliminary coagulation, sedimination, filtration, and chlorination. Studies have already been begun of the amount of coagulant, the pH of the coagulation, and the period of sedimentation. The preliminary study indicates "that the bacterial efficiency of coagulation and sedimentation is influenced very decidedly by the amount of coagulant added to the water, and to a measurable, although less marked extent, by the pH of the reaction and by the period of sedimentation, both these factors being operative, however, only within certain practical limits."

These experiments are being made with the objective of determining, so far as may be practicable, the limiting degree of pollution of streams at waterworks intakes consistent with the production of purified water supplies which, in accordance with current standards, may be regarded as safe for municipal use.

Activated Sludge Processes*

Studies made in England and the United States, recent developments, and advantages of the process.

By Walter C. Roberts†

The early history of the activated sludge method of sewage disposal credits two American investigators, Black and Phelps, with doing the first experimental work on the aeration of sewage in 1910. In 1912 the Massachusetts State Board of Health at Lawrence, Mass., conducted laboratory experiments by aeration of sewage in gallon bottles, and later in a small tank. The chief result of these early experiments was to prove that aeration of sewage had a marked clarifying effect and to greatly stimulate scientific interest in this method.

Dr. Fowler in Manchester, England, began experiments in 1913 and was the first to show the real value of mixing previously aerated sludge with fresh sewage. Bartow and Mohlman at the University of Illinois in 1915 conducted somewhat similar experiments. The City of Milwaukee started investigations in 1914 under direction of Hatton and Copeland. The subsequent work at Milwaukee has contributed much to the present knowledge of the activated sludge process.

A few years later the City of Chicago started on a 250 million dollar sewage disposal program and established a large experimental laboratory. A million dollar experimental plant was built where different types of equipment and methods of sewage disposal could be studied under actual working conditions.

Two other eastern cities have carried on extensive experimental work in connection with their activated sludge plants, Indianapolis, Indiana, and Houston, Texas.

Several European countries have carried on investigations on sewage disposal but in the field of activated sludge studies, England has the lead of other foreign countries. The English investigators have evolved new types of plants, three of which will be described later. They also use types of screens and other equipment not seen in this country. The cities of Manchester, Birmingham and Sheffield have conducted the most extensive investigations.

In Canada, particularly in the Province of Ontario, there have been several installations of activated sludge plants, mostly in small cities. These plants are reported as operating successfully but there is a scarcity of data on their efficiency and operation costs that makes comparison with other plants difficult.

In California, the City of Pasadena, together with adjoining territory, built an activated sludge plant which was largely modeled after the Milwaukee plant. Lodi has an activated sludge plant of a similar type to the Pasadena plant. The principal difference is in the method of sludge disposal. Another plant has recently been constructed at Pomona. The only other plant in operation in California is at the Folsom Prison.

The U. S. Public Health Service has just completed a plant at the Grand Canyon, which is a very complete small plant. After filtering and chlorinating, the effluent meets drinking water standards.

Taking up now the different types of construction, we find that the usual design for activated sludge plants consists primarily of four units. First, some method for removing the coarser materials in the sewage; second, aeration tanks; third, a clarifier; and fourth, some arrangement for sludge disposal. Provision is also made for the return of a certain amount of sludge from the clarifier to the raw sewage entering the aeration tank.

The removal of the coarser materials eliminates substances which would require long periods of aeration and gives an influent entering the aeration tank which contains only finely divided substances. This removal is accomplished by the use of bar screens and grit chambers followed either by the use of fine screens

*Paper before the League of California Municipalities.
†Director of the Pacific Engineering Laboratory, San Francisco.

or by sedimentation basins. Bar screens consist of iron bars placed from a half inch to an inch apart and remove the large solid particles from the sewage. The grit chambers consist of broad channels in which the rate of flow of the sewage is reduced to about one foot per second. These grit chambers follow the bar screens and remove gravel and other heavy solids.

Several types of self cleaning fine screens are in use which will give a satisfactory influent for the aeration tanks. It has been found that rotating cylindrical screens with short bevelled slots of not less than one-sixteenth of an inch in width give good results. This type of screen is preferred to a mesh screen. There is a tendency toward the choice of screens with a minimum of mechanical devices. Rotating cylindrical screens are used at Pasadena and Lodi. The use of settling basins for removing coarse solids is gaining favor. These have a smaller operating cost but larger initial cost than screening plants and take care of maximum flow conditions more easily. The use of Imhoff tanks as settling basins provides for the digestion of the settleable material and offers an opportunity to return the excess activated sludge there for final digestion and de-watering. Dorr clarifiers are used as settling basins at the new North Side plant at Chicago. An Imhoff tank is to be used at the new Pomona plant.

The period of detention in the settling basins and in the Imhoff tanks is the same and varies with the nature of the sewage. It is usually about one hour.

In the aeration tanks there are two principal methods of maintaining aerobic conditions in the sewage, one by agitation with air and the other by agitation with mechanical devices.

The aeration tanks for air agitation are rectangular with wide variations in dimensions, being built from 12-20 feet in width, from 70-300 feet in length and from 7-16 feet in depth. Air agitation is usually accomplished by forcing air under pressure through porous plates laid in rows at the bottoms of the tanks. The compressed air is furnished by power blowers capable of about 10 pounds pressure. The pressure necessary is but little more than that sufficient to force the air through the plates. The plates occasionally become partially clogged, requiring greater air pressure and may eventually need to be replaced. The air for the blower is filtered through air filters to remove any substances that would clog the plates. There are two general types of aeration tanks, the "ridge and furrow" and the "Manchester or circulating." The ridge and furrow type has the rows of plates perpendicular to the length of the tanks, each row being separated from the next by a ridge. The ridges prevent the settling of the sludge other than over the plates, where it is caught again in the rising current. The area of the porous plates is from one-fifth to one-tenth of the surface area of the liquid. This type of tank is in use at Pasadena and Lodi.

The Manchester or circulating type of tank has the plates arranged only along one longitudinal side of the tank which arrangement, with the aid of sloping baffles at the top and bottom, produces a rotating motion of the liquid. This method requires fewer plates, slightly less air, and mixes the sewage and sludge more thoroughly than in the ridge and furrow type. There are also the advantages of cheaper construction, lower power costs, and cheaper upkeep. The circulating type of tank is used at Manchester, England, Indianapolis, Indiana, and will be used in the huge new North Side plant at Chicago, and in the new Pomona, California, plant. The amount of air required depends on several variable factors, but is usually about 1.5 cubic feet of air per gallon of liquid treated. The Lodi plant has an enviable record in being able to use what is probably the lowest amount of air per gallon of sewage of any plant keeping authentic records. During most of the year the air consumption is reported at from .6 to 1.0 cubit foot of air per gallon of sewage.

The detention period for the sewage in the aeration tanks is about six hours for both the "ridge and furrow" and the Manchester tanks.

The sludge which is returned to the incoming sewage, is frequently reaerated or "reconditioned" in separate aeration tanks before it is used. These reconditioning tanks are usually built with porous plates in the bottoms to permit a constant aeration and to prevent the settling out of solids which might start septic action.

Experiments with the air diffusion type of plants indicate that oxygen is most rapidly dissolved from the air as the bubbles break on the surface of the tank and dissolves much more slowly as the bubbles rise through the liquid. The main function of the rising bubbles is therefore to agitate and mix the sewage and the added sludge. It seemed possible that some mechanical method of mixing and surface aeration could be found that would be as successful as air diffusion and easier and cheaper to operate. This has resulted in the manufacturing of different devices for this purpose. At least two of these are worthy of description.

A plant at Sheffield, England, circulates the sewage through narrow and comparatively shallow parallel channels arranged like cross baffles. Paddle wheels in each channel give the sewage an undulating motion similar to that seen in the water behind a stern wheel steamer, the wheels also give the liquid the same frothy appearance. The speed of the current is sufficient to prevent settlement and the length of the channels such that the undulating motion is continuous. This type of tank is claimed to be economical and successful but has not been widely adopted. There is no plant of this type in operation in the United States.

The "Simplex" type of mechanical aerator consists of an upright iron cylinder approximately twelve feet long and two and a half feet in diameter. This is set on legs in the bottom of a hopper bottom tank with about a six inch clearance, which permits a free circulation of

the liquid into the cylinder. Over the cylinder but not attached to it, is a revolving inverted cone about five feet across, the upper side of which is fitted with curved blades on edge. An opening is cut in the inverted apex of the cone the size of the cylinder. The cone is about the level of the liquid and throws it out in a spray drawing it up from the bottom of the tank through the cylinder. When the spray strikes the surface of the liquid, additional agitation is secured. The cone is driven from a power unit by a shaft which can be extended to run a series of aeration units. This type of plant has given satisfactory results experimentally in Chicago and Decatur, Illinois, and under operating conditions in a small city in Texas, and a unit is to be installed in California this year. The Simplex system has been installed in several British disposal plants and is being installed in a few American cities.

The clarifier following digestion makes it possible to decant the clear liquid and collect the sludge. Plain basins with steep hopper bottoms are used, but flatter bottoms with a mechanical device for scraping or squeegeeing the sludge to the center such as used in the Dorr clarifier, are more commonly found. The period of detention is from one to four hours.

The collected sludge contains 98-99.5 per cent of water and is easily handled by air lifts, pumps, or some type of ejector. A portion is returned to the sewage influent and the remainder to the sludge disposal system. The amount of sludge found necessary to return to the aeration tanks for best results varies from 12-25 per cent of sludge by volume. This amount can only be determined by experiment and is usually about 20 per cent.

The satisfactory disposal of the sludge produced by the activated sludge process offers, perhaps, the biggest problem found in such plants. The sludge from the clarifiers is a brown flocculent mass of organic matter of high bacterial content. It is slow to dry on sand beds, does not filter easily, and is difficult to handle in artificial driers. Efforts to get it into a form that can be readly sold as fertilizer, have not met with much success without excessive costs. A large amount of work has been done at Milwaukee, Chicago, Houston, and elsewhere in an effort to make this an economic possibility. Various mechanical filters have been tried in an effort to get sludge in a condition in which it can readily be dried. The treatment of the sludge with various chemicals such as sulphur dioxide, sulphuric acid, alum and ferrous sulphate has been tried in hopes of increasing its rate of filtration and has met with varying success. It is found that sludges from different sewages react differently under the same treatment. In the arid and semi-arid regions of the Pacific Coast it is likely that sand drying beds will be successful. This method has been used with good results at Lodi. The sludge must be placed in much shallower depths than would be used with Imhoff sludge. The method of sludge disposal in use at Indianapolis and Houston is to pump the sludge to large lagoons. The lagoons are usually under-drained. The sludge decomposes and partially dries with some odor and is flushed into a nearby stream during high water. Another method is to use the sludge for direct irrigation on agricultural land. Perhaps the most promising method is to digest the sludge, after mixing it with the coarse material taken out by preliminary treatment in Imhoff tanks. This not only offers a method for disposal of the coarse material but dewaters the sludge so that it can be more readily dried on sand beds. This causes the loss of some of the fertilizing value and greatly increases the initial cost of the plant. Researches have indicated that two or three times as much sludge capacity is required as is necessary in an Imhoff installation without activation.

The use of activated sludge plants as a preliminary treatment for sprinkling filters offers a promising future. The effect is to relieve the load of the filters, thereby increasing the filter capacity. Surprisingly large increases are possible in the dosage applied to the filters by the use of only limited detention periods in the aeration tanks. This makes it possible to supplement sprinkling filter systems with standby activated sludge units for use during peak periods. These periods of high flow are common in California as in resort cities having a large seasonal fluctuation in population, and in cities with seasonal industries such as canneries and packing houses.

The sanitary disposal of the trade wastes from many industrial plants is one of the biggest problems of the sanitary engineer. The advent of the activated sludge process and its application to trade waste problems, has opened up a new field for investigation. It is found that some of the wastes can be successfully treated by this method if mixed with domestic sewage, but not if treated separately without excessive costs for chemical precipitation. This again, is a problem which varies with individual plants and must be solved by local study of each particular trade waste.

There is no doubt but that the trade waste problems of many cities could be solved by properly designed activated sludge plants and that further studies will perfect methods for the treatment of wastes not at present successfully treated.

The comparatively high operating and maintenance cost of activated sludge plants has been one of the main objections to their adoption. The mechanical types show a power economy and require less labor attendance. So far data on the depreciation charges for this type are too meager to warrant any definite conclusions. It would seem that some form of mechanical aeration eventually will be found that will be the most economical form of activated sludge plant, especially for small installations.

The initial cost of an activated sludge plant is no greater than that of other methods giving as high grade an effluent.

The higher operating cost of activated sludge

plants over other methods is due to more mechanical devices, higher power costs and a greater labor overhead. The cost per million gallons including depreciation, interest, labor, power, etc., has been found to run from $20 to $50 in the few plants where data is available. The initial costs of the plants vary from $10 to $30 per capita.

The wide variation in these cost figures serves to emphasize the fact that each municipality has a separate sewage disposal problem of its own and that cost data of other cities may not be at all applicable. Thorough preliminary investigation is necessary to economically design a sewage disposal system, whether it be an activated sludge plant or one of the other types. High operating, repair and alteration costs of many plants are directly due to a lack of preliminary investigations.

In closing, I want to sum up the advantages of the activated sludge method of sewage disposal:

First—There is but little offensive odor or fly nuisance.

Second—A plant can be built on a comparatively small area and near the city if necessary.

Third—The effluent can be easily chlorinated and as it contains dissolved oxygen, it throws no burden on the receiving stream.

Fourth—The effluent has little or no harmful effect on fish or other marine life.

Fifth—The method is particularly adapted to the treatment of sewage containing trade wastes.

Sixth—A sludge of relatively high fertilizing value is obtained.

Seventh—The effuent is well adapted for irrigation of any agricultural crops. It also contains nitrates and mineral salts of appreciable fertilizing value. Where water costs are an important item as in many California communities, it is an economic waste not to use the large volume of water that could be made available by such sewage treatment plants.

The advantages of the activated sludge method of sewage disposal here outlined would seem to more than counterbalance any increased cost over other methods and should result in its increased popularity.

Typhoid Epidemic at Akron, N. Y.

What is said by State Health Officials to be the most serious outbreak of typhoid which has occurred in any similar area in the state within recent years broke out some weeks ago in Akron, N. Y., more than 200 persons out of a population of 2,000 having been ill with the disease, The State Health Department assigned two physicians and ten health department nurses, the Erie County Chapter of the Red Cross also sent ten nurses, and fifty private nurses have been employed for these cases.

There is said to be no question but that the epidemic is due to the water supply, which was known to be polluted but was continued in use, although an effort had been made to eliminate danger by the use of chlorine. In 1920 the State Health Department had advised a safer supply and the local Chamber of Commerce had seconded this advice, but nothing came of it further than the installing of a chlorinating apparatus. During August the chlorinating apparatus had been out of order and its use was discontinued for several days, and it is believed that most of the cases were due to the water drunk during that intermission of the chlorinating treatment.

The John Fritz Medal

On October 15th, the John Fritz Gold Medal was awarded to Elmer Ambrose Sperry, of New York, for the development of the gyro-compass and the application of the gyroscope to the stabilization of ships and aeroplanes. Presentation of the medal will take place at 8:30 Tuesday evening, December 7th, in the Engineering Auditorium, 29 West 39th Street, New York.

Street Cleaning in Wilkes Barre

Terms of contract under which cleansing is performed by hand brooms, machine sweeping, and high-pressure motor flushing.

The city of Wilkes Barre, Pa. has contracted for the cleaning of its streets, such contract having gone into effect May 1st, 1925, to be continued for three years from that date. Contractors were asked to bid on three different methods of cleaning, one of these with the use of hand patrol cleaning, machine sweeping, and high-pressure motor-driven flushing; another by hand patrol and high-pressure motor-driven flushing, without machine cleaning; the third by hand patrol and "any other approved method found in use," such method to be named by the contractor and approved by the city.

Cleansing is defined as "the entire removal of all animal droppings, pavement ditritus, leaves and miscellaneous rubbish which has been dropped or in any manner placed in the street." No cleansing is required on Sundays, New Year's, Fourth of July, Labor Day, Thanksgiving or Christmas, except as specified below.

The year is divided into two periods, a summer period extending from April 1st to December 1st, and a winter period from December 1st, to April 1st, the methods of cleaning and of payment differing in the two periods.

The total area of streets subject to cleaning is divided into six groups, with a different schedule of cleaning for each group, these being as follows: Group 1A includes 248,800 square yards, which area is to be cleaned every day, both summer and winter, by patrol hand cleansing, and every other day during the summer period by motor flushing. Group 1B, totaling 56,400 square yards, is to be cleaned every other

day by patrol hand cleansing and flushed once a week. Group 2, totaling 18,100 square yards, is to be cleaned by machine brooms every day during the summer period and by motor flushing once a week, each flushing taking the place of one machine broom cleansing. Group 3, totaling 21,900 square yards, is to be cleaned by machine brooms every other day during the summer period and by motor flushing once a week. Group 4, totaling 191,800 square yards, is to be cleaned during the summer period by machine brooms every other day and by motor flushing once every two weeks, each flushing taking the place of one machine broom cleansing. Group 5, totaling 403,600 square yards, is to be cleaned during the summer period by machine brooms every third day and by motor flushing once every two weeks, each flushing taking the place of one machine cleansing. Group 6, totaling 46,900 square yards, is to be cleansed every Sunday morning during the year, except when snow lies on the pavement, before the hour of 7:00 A. M. by machine broom cleansing. (This is in addition to cleansing during the week, this area being included in group 1A). In addition, the contractor is to provide and include in the bid for the several districts, the furnishing of at least 200 cans for receiving refuse and empty these and dispose of the contents; these cans to be of the style known as half-hooded, constructed of heavy galvanized iron and painted a dark green with a white band and lettered with the words: "It is unlawful to cast litter upon the street, please use this can." All material removed from the refuse cans and also sweepings from the streets are to be removed by the contractor and disposed of at his expense, at places satisfactory to the superintendent.

The hand patrol method is used on a total area of about 250,000 square yards of street cleaning, which is divided into twenty-five districts with a patrol or block man for each district. The equipment of the patrol block man consists of a hand cart holding a collecting can, a push broom with a scraper on the back, and a hand scraper. Patrol block men are supposed to be at work constantly between the hours of 7:30 A. M. and 5:30 P. M. Material swept up by them is to be deposited at once in their cans and these cans left in locations approved by the superintendent and collected not less than twice each day.

The number of machine brooms required is upon a basis of 30,000 square yards per day per broom. Whenever the condition is such that the broom raises a dust, the street must be sprinkled by the contractor so as to dampen the dust but not create mud. Where freezing weather makes it impracticable to sprinkle, machine broom cleaning must be done between the hours of 9:00 P. M. and 7:00 A. M. The water required by the contractor for sprinkling, flushing, or other purposes must be obtained from the private water company which furnishes the public supply of the city and paid for by the contractor, who must make his own terms with the company for the same. In sweeping the streets, the contractor is required to use the common method of sweeping, working the dirt from the center of the street to the gutter, where men with hand brooms sweep it into piles and load it into wagons, such piles of dust to be removed within two hours after the sweepings have been thrown into the gutter. Material which is removed to the gutters by the flushing machine is to be carted away as soon as it has dried sufficiently for handling. It is specified that machine brooms shall have split bamboo bristles with a length not more than fourteen inches from the axle, bristles to be removed when the length is less than four inches or whenever the sweeping done is not satisfactory to the superintendent of streets.

The motor driven flushing machines must have water tanks holding at least 1,200 gallons, discharging water from nozzles at a pressure of at least 50 lbs. per square inch until the tank is empty, the nozzles to be adjustable in elevation and angle so as to secure the most effective direction of flush. The number of machines required is based upon a minimum average of 90,000 square yards flushed per day of 8 hours for each machine.

During the winter period the block men remain at work on their respective blocks as specified in the summer period schedule, except when snow is on the street pavements, at which time they are responsible for cleaning and keeping clean along the paved streets, keeping ice and snow cleared away for 4 feet on each side of all fire hydrants and sewer inlets, and collecting and removing from the paved streets as much of the droppings and refuse as is possible. Block men may be called from their respective districts by the Superintendent for cleaning streets in other parts of the city, in which case the contractor is paid as though they were working in their own territory. In addition to this, during the winter the contractor must be prepared to furnish at all times such men, machine brooms and trucks as may be necessary for removing or handling snow. For this work the contractor bids a separate price per hour per man and per machine, including machine brooms, sprinkling machines and motor driven flushing machines, and trucks of not less than 2½ ton capacity, the flushing and sprinkling machines to travel at a rate of at least five miles per hour.

The general performance of the contract is under the supervision of an inspector, who is responsible to the superintendent. Both the contractor and the inspector must each day furnish to the superintendent a complete report of all streets cleaned by each method during the previous day, together with the total number of cubic yards of street cleanings and refuse removed each day.

The contractor is paid semi-monthly, on the basis of estimates signed by the superintendent and counter-signed by other officials; 90 per cent of the amount of the estimates being paid to the contractor and ten per cent retained until the termination of the cleansing period.

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Street Cleaning Accounting

Every municipal official in charge of street cleaning should keep such records as will enable him to determine what it is costing, per thousand square yards, to keep his streets satisfactorily clean by each method in use; such accounts to include not only the wages paid out and cost of operating street machines, but also interest, depreciation and upkeep of all equipment used, water used, and overhead. He should also keep himself informed on what these and other methods are costing other cities.

The reason for this is explained in the first article in this issue. Such information may enable Kansas City to save $100,000 a year.

A superintendent who does not know from actual figures what each method of cleaning is costing him per unit area, may be missing an opportunity to save the taxpayers a very considerable sum; and so be a liability to the city rather than a valuable asset.

Lower Cost Brick Pavement

The Bureau of Public Roads has been studying the practicability of reducing the thickness of brick in brick pavements and the result was told in the October issue of PUBLIC WORKS. Briefly stated, it was that 2½ inches thickness of brick properly laid will give as satisfactory results under heavy traffic as brick 4 inches thick, while 2-inch brick will be satisfactory for light residence street traffic.

The most important feature of this finding is the reduction in cost of pavement which this makes possible without in any way diminishing the durability of the same. The engineers of the bureau calculated that, based on the cost of a 3-inch pavement, the saving for each half in. reduction in thickness would be approximately 10% in manufacture and 16% in freight, haulage and filler. The ratio between cost of manufacture and that of freight and haulage would, of course, depend upon the distance the brick has to be transported. It may be conservatively estimated that the savings amount to 15 or 20 cents per square yard per half-inch thickness. This would mean a saving of this amount by the use of a 2½-inch brick instead of 3-inch, or the saving of 45 to 60 cents per square yard where a 4-inch thickness of brick had previously been used. Also, for resident streets where 2-inch brick is used, the saving in cost, as compared with 4-inch, would be 60 to 80 cents per square yard.

If we assume that the majority of brick pavement now laid is 4 inches thick and that this is reduced to 2½-inch pavements, while a similar averaged reduction is made from thinner residential street pavements to 2-inch pavements, or a general reducing in thickness of 1½ inches in all pavements, we have an average saving of about 50 cents per square yard on all brick pavements laid. The paving brick sold in 1925 was sufficient to lay more than 10,000,000 square yards of pavement. Had the thinner brick been used, this then would have permitted a saving of about $5,000,000 to the taxpayers of the country.

In view of the apparent definiteness and decisiveness of the report of the bureau, including its investigation of thin brick pavements which have already been laid and in practical service for a number of years in several cities, there would seem to be no reason why 4-inch brick should be laid in the future except perhaps for unusually severe service.

Other findings of this investigation also are deserving of careful consideration, among them being the greater effectiveness of a plain sand cushion as compared with a sand-cement cushion. Here again there is a saving in the cost of the cement, and with even greater efficiency. Another conclusion—that an old macadam or gravel road which has been in service for years and which will not be disturbed in the future for excavating for house connections, etc. will make as satisfactory a foundation as a new concrete foundation—has already been realized and frequently stated by advocates of brick and other block pavements.

Street Cleaning Notes

Some details of methods and costs in Detroit, Galesburg and Clinton, Ill., and Ashtabula, O.

IN DETROIT

Street cleaning procedure in Detroit is outlined for us by D. R. Thompson, superintendent of the Division of Municipal Waste as follows: "Two of our sweepers work on alternate night schedule, and the flushers work on a once-a-week schedule. Our horse drawn sweepers are used intermittently in the outlying districts and no record is kept of their mileage or yardage. Our downtown section is flushed every other night and main arteries once a week. All equipment is worked on a double shift except horse-drawn sweepers. In all of our street cleaning we use sweepers and flushers alternately and supplement their work by white wings in the down-town section and by alley cleaning gangs in the outskirts."

The expenditure for street cleaning during the last fiscal year was $2,158,100, which includes labor of men employed on the collection and disposal of ashes and rubbish in alleys, which last year amounted to $1,880,000. The total budget for last year for street and alley cleaning, maintenance of unpaved streets, grading newly opened streets, snow removal, removal of garbage, and some miscellaneous small expense, was $7,500,000. This included the purchase of new equipment. This year the city has purchased $216,000 of new equipment.

During the past year, Detroit applied mechanical cleaning to its downtown loop section, which is swept one night and flushed on the alternate night. The result has been highly satisfactory and greatly improves the cleanliness of the city as well as reduces former hand labor cost.

IN GALESBURG, ILL.

In Galesburg, Ill., the cost of cleaning paved streets, from April 1st, 1925 to April 1st, 1926 is given by A. C. Butler, superintendent of the Street Department, as follows:

Sweeper operator, sweeping 912 hours	$577.95
Truck drivers and laborers, 4,837 hours labor	2,661.63
Building brooms, repairing sweeper, etc., 576 hours	363.65
Repair parts for sweeper, outside labor, etc.	300.61
Broom material	267.08
Cost of operation of trucks, 2,154 hours approx. (Depreciation, gas & oil, repairs, etc.)	981.99
Gas & oil for sweeper, approx.	201.21
Depreciation on sweeper	868.40
Total cost of all street cleaning	6,222.52

The pickup sweeper traveled 1,601 miles cleaning 9,389,119 square yards of pavement. Where dirt had been washed into low places by heavy rains it was piled by hand; as was also heavy accumulations of dirt in the spring and of leaves in the Fall, the latter being performed by scraping up with a grader and piling with a Fresno scraper tied behind the grader.

IN CLINTON, ILL.

An explanation given by Roy J. Johnson, superintendent of streets of Clinton, Ill. would, perhaps, serve with some modifications for a number of cities which failed to reply to our questionnaire or gave very little information concerning their street cleaning. Mr. Johnson says that the street department force consists of four men, besides himself, one of whom owns a team and wagon which he works on the street. The department has one horse-drawn machine broom and about two dozen push brooms. A Model K. Cletrac tractor is used for pulling a road grader and a drag and for other purposes, and there are three wooden V-shaped horse-drawn snow plows. The four men do not work all of the time on street cleaning, and on the other hand occasional extra labor is hired for that purpose; and no record is kept of the time devoted to street cleaning separate from that of the other duties of the street department. Occasionally, the pavement around the business section of the city is flushed by use of fire hose.

IN ASHTABULA, OHIO

Prior to 1924 hand brooms were used for cleaning the streets in Ashtabula, but about the beginning of that year this was discontinued and a pick-up sweeper was substituted. The superintendent of streets, J. W. Green, has furnished us with figures concerning the operation of the sweeper for the year 1925.

During that year the sweeper operated 1,240½ hours, travelling 3,121 miles and covering 18,307,786 square yards, from which it collected 1,608 cubic yards of sweepings.

The average life of the rotary brooms was 123 miles and that of the gutter brooms 168 miles.

The cost of operation given includes wages of operators at $5.40 per day, and of helper, cost of gasoline, oil and grease, and material and labor for filling rotary brooms and gutter brooms, of labor and material for repairs, and depreciation at 20% on $6,406 and interest at 5%. The helper was used for heavy sweeping only and the total wages for the year for such helper was $75.25. The operators' wages amounted to $1,059.01. Gasoline cost $341.17 and oils and grease $16.19, giving a total of $1,491.62. Material and labor for filling the brooms totaled $749.82 and repair parts and labor on repairs $831.20; a total of $1,581.02. These items, with depreciation and interest totaling $1,602.00 gives a total cost of sweeping of $4,674. This is equivalent to a cost per thousand square yards of 8.14 cents for operation only, 16.8 cents for operation and maintenance only, and 25.5 cents for operation, maintenance, depreciation and interest. Picking up and hauling away the dirt collected cost $689 for labor and $536 for truck operation, depreciation and maintenance, giving a unit cost of 6.69 cents per thousand square yards.

Garbage Collection and Disposal

Can collection, hog feeding, incineration, reduction and the Beccari system. Practice in several cities described in symposium on the subject by the Sanitary Engineering Division, American Society of Civil Engineers.

A symposium on garbage collection and disposal was held by the Sanitary Engineering Division of the American Society of Civil Engineers at the annual meeting this year, at which six papers were presented; one giving a general review of the problem, by Samuel A. Greeley; another in which Edward D. Rich described the collecting and disposing of garbage at Lansing, Mich.; another by W. T. Knowlton describing the practice of garbage disposal by hog feeding at Los Angeles, Calif.; a description of the Beccari system at Scarsdale, N. Y., by Arthur Boniface; one of high temperature incineration at Toronto, Canada, by J. A. Burnett; and the Cobwell system of garbage reduction and some phases of its operation at Rochester, N. Y., by John V. Lewis.

Mr. Greeley described briefly some of the administrative and engineering problems in projects for the collection and disposal of garbage. He suggested an explanation of the fact that cities, even up to the present time, have not consulted engineers in connection with refuse collection and disposal as much as the engineers think would have been wise, by showing that, as compared with sewerage, water supply, etc., collection of garbage (and to a less extent the disposal of the same) is much more largely a problem of administration and organization than of engineering. For example, in a city of several hundred thousand population the construction cost of a complete garbage disposal plant may be from $0.75 to $1.00 per capita, while the cost of a sewage treatment plan would probably be ten times as great. The operation of the garbage plant, however, would require three or four times as many men as might be required in the operation of the sewage treatment plant. "The collection and disposal of garbage is one of the least costly municipal enterprises to acquire and one of the most expensive to operate. This emphasizes the administrative aspects of the work as compared with the engineering."

The collection and disposal of garbage is more expensive in annual operation than most other municipal enterprises, and the collection part usually involves at least 75% of the garbage budget.

After discussing in some detail the several methods open to cities for disposing of garbage, the author outlined the procedure recommended to cities confronted with the problem. This was as follows:

a.—A choice should first be made between municipal and contract operation. If contract operation is selected, the specifications and contract should cover in detail the service to be rendered and the standards of operation required, as described for Kansas City. If municipal operation is selected, the procedure is somewhat different as indicated by the following items.

b.—The collection problem should first be studied and developed in sufficient detail to insure satisfactory service to householders, reasonable economy, and proper coordination of the collection and the disposal.

c.—A site or sites for disposal plants should be acquired which suit the collection service, and which can be clearly established as integral parts of a sound general plan for garbage collection and disposal for the community as a whole. This general plan must be sufficiently sound to survive injunction proceedings.

d.—The method of disposal best suited to local conditions and available sites should next be determined. The method selected should be defined as far as possible to promote a ready comparison of bids and yet to encourage competition.

e.—The City should then prepare detailed plans for the grounds, approaches, buildings, chimneys, and other appurtenances including the general arrangement of equipment, such as furnaces, boilers, driers, digesters, storage facilities, etc. These plans should be detailed to the greatest extent possible with due regard to maintenance of competition in the equipment field.

f.—The drawings should be accompanied with complete specifications in general accord with the arrangement and topics described elsewhere in the paper. These specifications should reasonably and justly protect both the city and the contractor by the elimination as far as possible of uncertainties and hazards.

g.—The specifications as outlined will require reference by equipment bidders to works now in operation similar to those offered in the proposal. Such operating equipment for the two or three more favorable proposals should be inspected and tested as operating units before selecting the most favorable bid. Such a procedure will temper the bids to a reasonable basis and will enable a fairer selection where the selection has to be made on a performance basis.

h.—Some plans detailing the equipment offered will be included with the proposal. Other construction drawings will be required of the contractor. All such plans should be carefully checked and approved by the engineer prior to and during construction.

i.—Construction should be carried out under careful engineering supervision and inspection. Some failures may be charged to poor construction work.

j.—After the plant is built, careful and fair operating tests should be made before acceptance. It is likely that recognition on the part of bidders that acceptance tests are to be made by competent, fair-minded engineers will promote safer and better bidding and will eliminate part of the contingent item in the bid.

k.—After the work is finally accepted, a satisfactory operating routine with adequate records should be established.

This procedure will be better followed if it is entrusted to experienced, disinterested engineers. Probably the best way to obtain results is through the development of a public opinion which understands the administrative and engineering aspects of the collection and disposal of garbage.

In connection with incineration, Mr. Greeley referred to the reports of the committee on refuse collection and disposal of the American Public Health Association, which was abstracted in PUBLIC WORKS for November, 1925. Under specifications recently prepared by him for the receipt of bids, the work was classified under five heads. (a) Incinerator furnaces with all appurtenances; (b) Incinerator building and scale; (c) Chimney; (d) Runway; and (e) Sewers and sewage disposal plant. Perhaps the most notable feature of these specifications was the requirement of references to operating incinerators similar to those proposed.

In discussing reduction plants, the author gave a list of those in operation, which were as follows: Baltimore, operated by contractor; Boston, by contractor; Chicago, by city; Cincinnati, by contractor; Cleveland, by city; Columbus, by city; Detroit, by contractor; Indianapolis, by city; Philadelphia, by city; Pittsburgh, by contractor; Rochester, by city; Schenectady, by city; Syracuse, by contractor; Washington, by city.

In preparing for and carrying out the feeding of garbage to hogs, comparatively little engineering work has been involved, although it is desirable to carefully design the buildings and grounds, unloading facilities, distribution arrangement, roadways, hog houses, and yards, feeding platforms, water supply, drainage and sewerage, farm buildings, silos, etc.

The author described in some detail the procedure under which Kansas City is now having its garbage collected and disposed of. This he prefaces with the statement that two general methods are open to a city, one to describe in some detail the methods to be employed by the contractor in disposing of the garbage, the other to leave the manner of disposal open, merely making such provision as will insure satisfactory and sanitary operation. The Kansas City contract, which was awarded last year and has been in operation since the early summer of 1925, provides for the collection and disposal of garbage for a term of ten years and furnishing all necessary plans, statements, equipment, buildings, plants, apparatus, sidings, land, labor, horses and appurtenances. The garbage may be disposed of by any method shown to have a satisfactory record elsewhere. There must be a proper handling of residual products, including unconsumed garbage at hog farms, manure at hog farms, ashes from incinerators, sewage (including floor washings, grease liquors, etc.), gasses from driers and incinerators, tailings and rubbish from recovery processes, and tin cans and tinware. Temporary methods of disposal were permitted and such methods were still in use at the time this paper was written. The collection service, however, has been developed into a first class condition and from about 100,000 houses there have been received only about twenty-five complaints of non-collection service per day. The contract price is $6.45 per ton for collection, and $1.00 per ton for disposal.

CAN COLLECTION

Perhaps the most interesting feature of Mr. Rich's description of garbage disposal at Lansing was the collection of the garbage in the cans, with the several details of the same. The cans have a capacity of about one bushel and are tapered, smaller at the bottom. A 2½ ton or 3 ton motor truck has been found to be most satisfactory and economical for the collection. Calls are made daily at hotels and restaurants, and weekly at residences. In making the collections, can covers are not collected, but the cans are nested on the trucks, which allows carrying many more than would otherwise be possible. Mr. Rich said that if the nesting is done carefully no garbage is spilled on the ground or from the truck.

It is believed that collection by tank wagons would be cheaper, but considering the advantages of efficiency and satisfactory service to the householders and also the condition of the garbage, the additional expense seems justifiable. The elimination of the disagreeable task to the housewife of washing garbage cans is a distinct service which is highly appreciated. This collection also insures a uniformity of adequate receptacles and the cleaning of these which preserves the freshness of the garbage.

At the end of each trip the truck is washed by hose, and each can is washed and sterilized with hot water before being returned. The cans are washed in a machine constructed especially for that purpose in a building near the feeding houses (the garbage is used for feeding hogs). This building also contains a room with steam pipes in the floor for thawing garbage in the cans so as to avoid damage in removing frozen

garbage; and a steam plant for heating and to furnish hot water for can washing and floor scrubbing.

The city makes a charge of $1.00 per year for each can in use, this money being kept in a separate fund for maintaining the supply of cans. Mr. Rich, however, questions the wisdom or necessity of making any such charge. The amount received from can fees for the four years that the system has been in operation has steadily increased from $8,404 in 1921 to $12,884 in 1924. It is stated that the cost of supplying the cans has just about equalled the receipts from them, there being a deficit in some years and in others a profit. A reserve supply of about 1,000 cans is kept on hand, with about 12,000 in use. In 1924, there were 11,800 patrons served, which gives a population served of 48,970 on the basis of 4.15 persons per family as determined by the 1920 census. The cost of garbage collection that year was $0.66 per capita of total population or $0.91 per capita of the population served, or $3.76 per patron. This cost includes labor, repairs to equipment, gasoline, salary of the superintendent and his office expenses, interest at six percent on the value of five trucks at $2,000 each, and depreciation on these trucks at 14%. The cost per patron was $4.78 in 1921, $4.93 in 1922, and $3.96 in 1923.

HOG FARMS

As to the operation of the hog farm, figures were available for only one eight-month period in 1923, when the total expenses, including taxes, interest on the cost of the farm, insurance, labor, repairs, materials and depreciation totaled $25,539, while the receipts from sale of hogs, from farm produce, and from increase in value of the hogs on hand at the end of the period, totaled $34,617, giving a profit for eight months of $9,078.

Following suits brought by neighbors asking for an injunction against the hog farm, the city has recently adopted improved methods of disposing of the waste materials from the feeding floors at a consequent greater cost in operation.

In September, 1921, the city of Los Angeles, California entered into a ten-year contract to sell its garbage for hog feeding, receiving $0.60 per ton for the garbage loaded onto cars. It is collected by the city and shipped by steel gondola cars to a hog ranch 55 miles from the loading station. The garbage is not only kept separate from other refuse, but is classified, that collected from restaurants being used for fattening hogs, and that from residences for the smaller hogs which have not reached the fattening stage. In the business district garbage is collected every night and in the apartment house district and thickly populated residential district three times a week, and twice a week in the general residential district. In 1925, the average collection of garbage was 371 tons a day; this being the same as in 1924, while in 1922 246 tons were collected, and in 1921 216 tons per day. About 50 tons of this is rejected by the pigs as unsuitable for eating and is removed to a compost pit, where it is covered with gypsum to prevent evaporation of the ammonia content. After being in the pit for four months, the material is removed by trucks and this and hog manure and clean-up from pasture and pens is spread on a concrete floor to dry. The moisture content is reduced in the compost pit from 75% to about 42%. After drying to about 5½% water it is ground up quite finely and used as fertilizer in the orchards and vineyards of the property.

(To be continued)

Street Cleaning Tables

Apparatus used, areas cleaned last year by each of the several appliances and methods, and expenditures for street cleaning, in cities of all sizes from two thousand to six million.

Apparatus Used. Changes in Methods

City	Population 1920 census	Appliances used last year: Machine brooms	Pick-up sweepers	Motor flushing machines	Adopted during past 3 years	Discontinued during past 3 years
Alabama:						
Bessemer	18,674	.....	.....	.....	.....	Horse sweeper
California:						
Los Angeles	576,673	.....	6 vacuum	10	.....	.....
Napa	6,757	.....	.....	1	.....	.....
Palo Alto	5,900	.....	2, 1 vacuum	.....	Pick-up sweepers	None
Sacramento	65,908	1 motor	.....	2	.....	Vacuum cleaner
Santa Ana	15,485	.....	3	.....	Pick-up sweepers	Hand sweeping
Colorado:						
Denver	256,491	17 motor	7	10	.....	Horses
Montrose	3,581	.....	.....	.....	.....	Horse sweeper
Pueblo	43,050	.....	.....	.....	Patrol truck with 2 sweepers	None
Connecticut:						
New Britain	59,316	.....	.....	1	Motor flushing	.....
District of Columbia:						
Washington	437,571	17 horse	.....	10	Additional flushers	Motor brooms

City	1920 census Population	Appliances used last year: Machine brooms	Pick-up sweepers	Motor flushing machines	Adopted during past 3 years	Discontinued during past 3 years
Florida:						
Fort Pierce	2,115	.....	1	.....	Pick-up sweeper	Fordson tractor
Miami	29,571	.....	3	.....	None	Horse-drawn carts
Georgia:						
Brunswick	14,413	.....	.....	.....	None	Horse-drawn broom
Rome	13,252	.....	.....	1	.....	.....
Idaho:						
Lewiston	6,574	.....	.....	1	.....	.....
Pocatello	15,001	.....	.....	2	.....	Pick-up sweeper
Illinois:						
Galesburg	23,834	.....	1	.....	Pick-up sweeper	Horse sweepers & large part of hand cleaning
Hinsdale	4,042	1 horse	.....	.....	.....	.....
Rockford	65,651	.....	2	1	.....	.....
Indiana:						
Clinton	10,962	1 horse	.....	.....	.....	.....
Iowa:						
Atlantic	5,329	.....	.....	1	Hand brooms in business district	Machine brooms
Cedar Rapids	45,566	.....	.....	1	None	Squegee & sprinklers
Kansas:						
Horton	4,009	1 horse	.....	1	Flusher	Machine broom
Louisiana:						
New Orleans	387,219	.....	1	4	Pick-up sweeper	.....
Maine:						
Gardiner	5,475	1 horse	.....	.....	.....	.....
Massachusetts:						
Framingham	17,033	1 horse	.....	.....	.....	.....
Mansfield	6,255	1 horse	.....		.....	.....
Michigan:					.....	.....
Detroit	993,678	29 horse 6, 1 vacuum		7		Horse sweeper
Kalamazoo	48,487	2 motor	.....	.....	Truck & helper behind each motor sweeper	
Niles	7,311		.....		Motor truck	..Horses & wagons for.. street sweepings
Missouri:						
Mexico	6,013	1 horse	.....	.....	.....	.....
Montana:						
Great Falls	24,121	1 motor	1	1	Pick-up sweeper	Flusher
Havre	5,429	.....	.....	1	.....	.....
Miles City	7,937	.....	.....	1 horse	.....	
Missoula	12,668	.....	.....	1	.....	.....

Expenditures for Street Cleaning

City	For labor	New equipment	Other expenses	Method of cleaning	Cost per 1,000 sq. yd.
Alabama:					
Gadsden	.....	.....	$4,427d	Flushing & hand sweeping	$23.93
California:					
Los Angeles	$618,694	$29,644	56,961	Hand brooms	636.207d
				Pick-up sweepers	41.345d
				Flushing machines	83.629d
Napa	2,065	25	.....	Hand brooms	0.15 c
Palo Alto	11,825a	6,200	16,800	Pick-up & hand brooms	16.00
Sacramento	60,000	7,600	.....	.....	.....
Colorado.					
Denver	243,900	18,000	42,000	.....	.....
Montrose	970	.....	.....	.....	.....
Pueblo	5,900	1,200	2,750	.....	.....
Connecticut:					
New Britain	21,826	.....	.....	.....	.....
New London	9,500	.....	2,600	.....	.....
Rockville	4,000	None	None	.....	.....
Southington	3,000	.....	.....	.....	.....
Willimantic	4 500	None	.....	.....	.....
District of Columbia:					
Washington	335,000	30,000	65,000	.....	.....
Florida:					
Fernandina	280	20	.....	Hand brooms	20.00
Fort Pierce	2,808	6,900	.....	.....	.....
Miami	87,000	13,000	22,000	.....	.....
Georgia:					
Brunswick	2,436	76	None	Hand brooms weekly	25.00
Cartersville	858b	.....	.....	.....	.....
Rome	12,000	3,000	.....	Hand brooms	47.68
Idaho:					
Lewiston	2,500	200	.....	.....	.....
Pocatello	11,000	.....	4,000	.....	.....
Illinois:					
Galesburg	3,240	None	2,983	.....	.....
Hinsdale	7,500	1,000	.....	.....	.....
Lockport	2,838	.....	316	.....	.....
Oak Park	19,000	2,100	8,700	Hand brooms	1.74½c
			3,559d	Flushing by hose	0.08 c
Rockford	.....	.....	16,674d	Pick-up sweepers	0.382 c
Indiana.					
Clinton	2,500	.....	.....	.....	.....
Iowa:					
Atlantic	1,200	.....	.....	Hand broons weekly	5.00 c
				Flushing	0.20 c
Cedar Rapids	31,329	None	1,333	Flushing machines	0.16 c
Kansas:					
Belleville	1,020	36	.....	.....	.....
				Flushing	0.025 c
Horton	701	6,000	104	Machine brooms	0.01 c
Neodesha	3,500	.....	.....	.....	.....
Paola	.....	.....	70.00 per mo.	.....	.....
Louisiana:					
New Orleans	210,000	20,000	30,000	Hand brooms	0.30 to 0.75c
				Pick-up sweepers	0.15 to 0.25c
				Motor flushing	0.09 to 0.12c
				Hose flushing	0.80 to 1.00c
Massachusetts:					
Framingham	8,000	.....	.....	.....	.....
Mansfield	1,500	None	1,500	.....	.....
N. Attleboro	2,049	50	.....	Hand brooms	30.00
Northbridge	8,000	1,200	.....	.....	.....
Michigan:					
Detroit	278,500	31,020	.....	.....	.....
Kalamazoo	19,000	.....	1,750e	.....	.....
Missouri:					
Mexico	650	.....	200	Machine brooms & hand brooms	59.00
Montana.					
Great Falls	.....	7,200	.....	.....	.....
				Flushing machine & hand brooms	20.00
Havre	800	6,000	.....	.....	.....
Miles City	1,300	.....	100	.....	.....
Missoula	2,500	.....	.....	.....	.....

City	Population 1920 census	Appliances used last year: Machine brooms	pick-up sweepers	Motor flushing machines	Adopted during past 3 years	Discontinued during past 3 years
New Hampshire:						
Keene	11,210	......	1	......	Pick-up sweeper	Pick-up Cans
Manchester	78,384	......	1	2	Motor sweeper, snow loader	Horse sweepers and white wings
New Jersey:						
Newark	414,524	1 motor	1	7	Pick-up sweeper	Horse-drawn brooms
New York:						
Geneva	14,648	2 horse	......	......	....	....
Little Falls	13,029	......	1	......	Pick-up sweeper	....
Massena	5,993	......	1	1	Pick-up sweeper	Hand brooms
New York	5,620,048	100 horse	3 vacuum	167	Vacuum sweepers	....
Tarrytown	5,807	1 horse	......	......	....	....
North Carolina:						
Durham	21,719	......	2, 1 vacuum	2	Vacuum sweepers	....
Thomasville	5,676	......	1	......	Pick-up sweeper	Hand brooms
Ohio:						
Ashtabula	22,082	......	1	......	Pick-up sweeper	Hand brooms
Cincinnati	401,247	......	......	1 horse, 4 motor	....	....
Dayton	152,559	......	......	1	....	Pick-up wagons
Defiance	8,876	......	......	1 horse	....	....
Delaware	8,756	......	......	1 horse	....	....
Lakewood	41,732	......	1	......	Pick-up sweeper	....
Oregon:						
Oregon City	5,686	......	......	1	Flusher	Hand brooms
Pennsylvania:						
Jersey Shore	6,103	1 horse	......	......	....	Horse-drawn sweeper
Rhode Island:						
Providence	237,595	8 horse	3	......	Trucks to collect dirt cans	Wagons to collect dirt cans
South Carolina:						
Sumter	9,508	......	1	......	....	....
Tennessee:						
Clarksville	8,110	......	......	1 horse	....	....
Virginia:						
Bristol	6,729	1 horse	1	......	Pick-up sweeper	Horse sweeper
Fredericksburg	5,882	2 horse	......	......	....	....
Norfolk	115,777	4 horse	1	2	Pick-up sweeper	....
Richmond	171,667	2 horse, 4 motor	2	3	....	....
Staunton	10,623	1 horse	......	......	....	....
Gadsden	14,737	......	......	1	....	....
Washington:						
Seattle	315,312	......	......	6 horse, 3 motor	....	....
Spokane	104,437	......	3	3	Pick-up Sweepers	Horse-drawn sweepers
Wisconsin:						
Kenosha	40,472	......	2	1	....	....

New Hampshire:						
Keene	3,747	......	......	....	....	
Lebanon	800	35	......	....	....	
Manchester	47,845	......	......	....	....	
New Jersey:						
Newark	415,381	58,410	......	....	....	
Phillipsburg	[illegible]f	20	....	....	....	
Salem	1,165	......	1,248	....	....	
New York:				....	....	
Geneva	8,000	8,000	......	....	....	
Lackawanna	7,000	1,000	......	Hand brooms	800	g
Massena	871	......	......	Pick-up sweeper & flushing machine	0.11	
New York	6,111,466h	......	......	....	....	
Tarrytown	4,500	......	......	Hand brooms	56.50	
North Carolina:						
Durham	10,000	10,000	......	Pick-up sweeper	0.20	c
Thomasville	1,250	398	1,688	....	....	
North Dakota:						
Bismark	2,404	......	580	....	....	
Ohio:						
Cincinnati	64,052	......	25,090	White wings	0.293	
				Auto flushing	0.051	l
Dayton	45,615	None	None	....	....	
Defiance	4,000	......	......	....	....	
Delaware	3,243	......	......	....	....	
Oregon:						
Oregon City	2,700	3,900	430	....	....	
Pennsylvania.						
Freeland	708	......	192	Hand brooms	0.47	
				Hand flushing	0.60	
				Cleaning dirt roads	1.80	
Hazelton	8,811	......	......	Hand brooms	40.10	
Jersey Shore	1,600	......	......	....	....	
New Brighton	4,256	......	......	....	....	
Northampton	600	......	281	....	....	
Rhode Island:						
Providence	168,266k	......	4,158	Hand brooms	0.317	
				Machine brooms	0.182	
				Pick-up sweepers	0.154	
South Dakota:						
Lead	1,500	......	......	....	....	
Tennessee:						
Clarksville	1,152	......	......	Flushing machine	21.94	
Texas:						
Burkburnett	1,200	......	......	....	....	
Childress	1,728	......	......	....	....	
Virginia:						
Bristol	4,226	2,050	210	Pick-up sweeper	0.121	
				Machine broom followed by hand	0.230	
Fredericksburg	4,000	......	......	....	....	
Harrisburg	1,820	......	......	....	....	
Norfolk	288,472	6,000	......	Hand sweeping	0.2[illegible]	
				Horse drawn	0.427	
				Motor sweeper	0.131	
				Motor flushing	[illegible]	
Richmond	64,017	5,800	......	Hand brooms	0.7108	
				Machine brooms	0.4351	
				Pick-up sweepers	0.1472	
				Flushing machines	0.1130	
				Patrol	0.1488	
				Horse-drawn sweeper	0.5005	
Staunton	5,000d	......	......	....	....	
Washington:						
Seattle	18,456	8,000	19,690	Truck flusher, day	0.121	
				Truck flusher, night	0.18	
				Horse-drawn flusher	0.213	
				Hose by hand	0.391	
Spokane	38,809	6,952	45,748l	....	....	
Wisconsin.						
Kenosha	13,104	......	2,798m	Hand cleaning	4,901n	
				Pick-up sweeper	11,001n	
Stevens Point	4,578	......	......	....	....	

a—All cost except new equipment. b—For nine months. c—Each cleaning. d—Total expenditure. e—Cutting weeds and carting leaves. f—Per day. g—Per mile. h—Not including supervision, etc. i—Per square. k—Includes snow removal. l—Includes water for flushing and industrial insurance. m—Includes gas, oil and repairs. n—Includes hauling away sweepings.

Amount of Street Cleaning Done Last Year

City	By hand brooms: Area cleaned	By hand brooms: Cleaning done	By machine brooms: Area cleaned	By machine brooms: Cleaning done	By pick-up sweepers: Area cleaned	By pick-up sweepers: Cleaning done	Flushing machines: Area cleaned	Flushing machines: Cleaning done	Hand flushing by hose: Area cleaned	Hand flushing by hose: Cleaning done	Other methods of cleaning: Description	Other methods of cleaning: Area cleaned	Other methods of cleaning: Cleaning done
Alabama:													
Bessemer	70 mi.												
Gadsden	31,000						185,000				Flushing by night hand by day	31,000*	
California:													
Los Angeles	15,800,000				12,350,000	66,003,005	3,450,000	306,000,000			Total area both flushed or machine swept and hand swept	15,800,000	
Napa	21,000	6,550,000					21,000	252,000					
Palo Alto	75,000	Part Time			739,115d	1, 2 & 6 times a week							
Santa Ana					85 mi.								
Colorado:													
Montrose	31,800	3 to 14-day intervals											
Pueblo	15 mi.	Daily					32 mi.	Busi. daily, resi. weekly			Day sweeping night flushing	15 mi.*	Daily
Connecticut:													
New Britain	12-man patrol gang						Not stated	Some once, some twice a week			7 men with hoes clean gutters on macadam		
New London	147,600	524,600 per week											
Rockville	200,000		200,000										
Southington	13 mi.												
Willimantic	60 mi. gutters								1 mi.		Brooms and hose	3 mi.	
District of Columbia:													
Washington	5,925,000	1,603,576,000	445,000	111,305,000			4,605,607	566,451,000			Alleys Suburban Night flushing day hand cleaning	1,440,000 1,989,000 5,925,000	94,781,000 50,794,000
Florida:													
Fernandina	15,000												
Fort Pierce					10,560								
Miami		3,047,200				46,032,000			136,000		Hand brooms and pick-up sweeper		3,047,200
Georgia:													
Brunswick	100,000	Once a week											
Cartersville	18,000												
Rome	100,000						270,000						
Idaho:													
Lewiston	99,314	18,862,800					94,314	18,862,800					
Pocatello							300,000	25,000,000			Gutters swept, refuse picked up	300,000*	Each day; night flushing

Illinois:													
Galesburg	No record	.....	.....	.....	205,310	9,389,119	.....	.....	.....	.....	See special description	.....	.....
Hinsdale	100,000	.....	400,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oak Park		17,043,840	.....	.....	.....	.....	.....	.....	.....	.....	Dirt and leaves removed	11,295 cu yds.	.....
Rockford		.....	.....	.....	.....	43,647,127	.....	.....	.....	44,229,836	.....	.....	.....
Indiana:													
Clinton	No record	.....	No record	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Iowa:													
Atlantic	1,920	61,440	.....	.....	.....	.....	.....	4,550,000	.....	.....	Flush by night; hand brooms by day	.....	.....
Cedar Rapids		1,975,000	.....	.....	.....	.....	.....	1,975,000	.....	.....	Flush by night; pick-up by day	.....	.....
Kansas:													
Belleville	20,000	.....	.....	.....	.....	.....	.....	.....	12,000	.....	Hand cart and brooms a	32,000	.....
Horton		.....	.....	200,000	.....	.....	.....	15,000,090	.....	96,000	.....	.....	.....
Paola	14 blocks	.....	.....	.....	.....	.....	.....	.....	.....	.....	Gutters shoveled	.....	2 or 3 a year
Louisiana:													
New Orleans	3,000,000	300,000,000	.....	.....	250,000	15,000,000	600,000	75,000,000	25,000	1,500,000	All flushing is additional to other cleaning	625,000*	76,500,000
Maine:													
Old Town	9,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Massachusetts:													
Mansfield	1,660	.....	1,660	.....	.....	.....	.....	.....	.....	.....	Hand and machine brooms	1,660*	.....
N. Attleboro	7,000	.....	.....	.....	.....	.....	.....	.....	5,000	Occasional	Hand sweeping and flushing	5,000*	Occasional
Northbridge	2 miles	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Michigan:													
Detroit	No record	.....	.....	9,000,000	200 miles	114,000,000	200 mi.	15,000 mi.	None	.....	See special description	.....	.....
Kalamazoo	1,408,000	Once a week	1,408,000	.....	.....	.....	.....	.....	.....	.....	Leaves by hand broom and trucks	.....	.....
Missouri:													
Mexico	14,400	172,800	14,400	86,400	.....	.....	.....	.....	12,000	.....	.....	.....	.....
Montana:													
Havre	50,000	.....	.....	.....	.....	.....	50,000	.....	.....	.....	Night flushing, day sweeping	50,000*	.....
Miles City	21,611	.....	.....	.....	.....	.....	21,611	.....	.....	.....	Flushing and hand cleaning	21,611*	.....
Missoula		.....	.....	.....	.....	.....	146,640	.....	.....	.....	.....	.....	.....
New Hampshire:													
Manchester	No record	.....	No record	.....	No record	.....	No record	.....	.....	.....	Total cleaning per month	.....	122 mi.
New Jersey:													
Phillipsburg	58,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Salem	129,066	680,528	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Amount of Street Cleaning Done Last Year

City	By hand brooms: Area cleaned	By hand brooms: Cleaning done	By machine brooms: Area cleaned	By machine brooms: Cleaning done	By pick-up sweepers: Area cleaned	By pick-up sweepers: Cleaning done	Flushing machines: Area cleaned	Flushing machines: Cleaning done	Hand flushing by hose: Area cleaned	Hand flushing by hose: Cleaning done	Other methods of cleaning: description	Other methods of cleaning: cleaning done	Other methods of cleaning: Area cleaned
New York:													
Geneva	40,000	100,000,000	400,000	30,000,000	.....	.....	40,000	15,000,000	.....	.....	.....	.....	.....
Lackawanna	.....	10 mi.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
N. Y. C.	33,005,000	Daily b	600,000	Daily	270,000c	Daily	10,800,000	Daily	6,000,000	Daily	Flushing by hand or machine early morning, hand sweeping by day	17,400,000*	Daily
North Carolina:													
Durham	.....	.....	.....	.....	.....	24,000,000	.....	20,000,000	.....	.....	.....	.....	.....
Thomasville	.....	.....	.....	.....	220,000	11,726,638	.....	.....	.....	.....	.....	.....	.....
Ohio:													
Ashtabula	.....	.....	.....	.....	.....	18,307,786	.....	.....	.....	.....	.....	.....	.....
Cincinnati	.....	68,714,343	.....	.....	.....	.....	.....	143,712,000	.....	.....	Patrol	.....	48,819,000
Dayton	.....	46,920,000	.....	766,280,000	.....	.....	.....	670,780,000	.....	.....	Flushing and hand brooms	Congested area	.....
Defiance	229,061	.....	.....	.....	.....	.....	29,000	.....	.....	.....	.....	.....	.....
Delaware	.....	.....	.....	.....	.....	.....	116,533	.....	.....	.....	.....	.....	.....
Oregon:													
Oregon City	.....	.....	.....	.....	.....	.....	120,000	18,000,000	.....	.....	.....	.....	.....
Pennsylvania:													
Freeland	50,000	1,600,000	.....	.....	.....	.....	.....	.....	50,000	200,000	Dirt roads	10,000	40,000
Hazleton	219,675	23,065,140	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
New Brighton	No record	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wilkes Barre	304,400	85,593,000	682,300	46,276,000	.....	.....	940,600	40,215,000	.....	.....	All streets duplicated. See description	.....	.....
Rhode Island:													
Providence	600,000	172,800,000	104,777	19,907,630	185,953	92,974,000	.....	.....	.....	.....	Hand brooms & pick-up sweepers	600,000*	.....
South Carolina:													
Sumter	.....	.....	.....	.....	18 mi.	.....	.....	.....	.....	.....	.....	.....	.....
South Dakota:													
Lead	3 mi.	.....	.....	.....	.....	.....	.....	.....	57,840	.....	.....	.....	.....
Tennessee:													
Clarksville	.....	.....	.....	.....	.....	.....	52,500	.....	.....	.....	.....	.....	.....
Texas:													
Childress	20 blocks	.....	.....	.....	.....	.....	.....	.....	Some	.....	.....	.....	.....
Virginia:													
Bristol	.....	.....	.....	10,519,165	.....	14,726,831	.....	.....	.....	.....	.....	.....	.....
Fredericksburg	.....	.....	8,000	416,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Harrisonburg	2,000	780,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Richmond	No schedule	24,806,000	141,000	6,509,000	242,000	70,584,000	451,000	160,090	.....	.....	Patrol	399,000	103,039,000
											Horse-drawn sweeper	173,000	22,170,000
Staunton	365 mi.	.....	25 mi.	.....	.....	.....	.....	.....	.....	.....	Hand & machine brooms	Business center	.....
Washington:													
Everett	40 mi.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Seattle	.....	.....	.....	.....	.....	.....	.....	250,740,154c	.....	1,534,100	.....	.....	.....
Wisconsin:													
Stevens Point	192,553	.....	.....	.....	.....	.....	.....	.....	10,000	.....	Flush at night. hand broom by day	10,000*	.....

*Included in other figures given. a—Entire payment, about 9 miles, cleaned about four times a season. b—Hand sweeping daily all the year; other methods daily April 15 to Nov. 1 in 1925. c—Motor flushers by day, 143,242,908 sq. yds; by night, 81,188,876 sq. yds.; horse-drawn flushes, 26,308,370 sq. yds. d—Two sweepers, one a broom pick-up, the other a vacuum type.

Recent Legal Decisions

BUILDING PROHIBITION BY BOARD OF ADJUSTMENT HELD UNJUSTIFIABLE

The New Jersey Supreme Court holds, Scola v. Senior, 130 Att. 886, that an arbitrary limitation of an owner's use of his premises by order of a town board of adjustment by prohibiting him from erecting a store and apartment building within 15 feet of the exterior line of one street or within 7 feet of the exterior line of another, is without legal justification and therefore invalid.

RIGHT OF RECOVERY ON CONSTRUCTION CONTRACT

Where the sole issue tried in an action for material and labor for the construction of a number of concrete bridges and culverts was whether the work was done according to the specifications, and the evidence reasonably tended to support the verdict and judgment that plaintiff did not comply with the terms of the contract as to the ratio in mixing, it was held, Froebe-Brisco Const. Co. v. Board of Comrs. of Garvin County, 233 Pac. 468, that the contractor was not entitled to an instruction for the recovery of an item for unused material, hauling and freight, the action being upon an express contract, entire and indivisible.

MUNICIPALITY MAY ENJOIN OBSTRUCTION OF STREAM FLOWING THROUGH LAND CONDEMNED FOR CHANNEL

In straitening the course of a stream through a city, the city authorities condemned land through which a new channel for the stream was cut. Forty years later the owners of lots through which the new channel was cut began the construction of a large building, designed to extend over the stream, and had placed foundation walls and piers in the channel which necessarily impeded the flow of water. The Kansas Supreme Court, City of Hutchinson v. White, 233 Pac. 508, held that an injunction to prevent the placing of obstructions in the channel was properly granted. It was to be presumed that there was a necessity for the appropriation of land to carry off the water and that the quantity condemned was necessary. The fact that earlier officers of the city neglected to resist encroachments on the land did not preclude the present officers from preventing obstructions.

PUBLIC WORKS MATERIALMEN MAY BE PAID BEFORE SURETY COMPLETING THE CONTRACT

Where a public works contractor defaulted and the surety completed the contract, the Circuit Court of Appeals, Third Circuit, held, in an action by the surety against the obligee (commissioners of waterworks) for the entire unpaid contract price, Fidelity & Deposit Co. of Maryland v. Hay, 9 F. (2d) 749, that the surety had a right of subrogation only after it had settled the claims of those for whose benefit the bond was given, and the obligee could retain money to pay such claims, since, under the contract, the contractor, if it had completed the reservoir, could not have taken the unpaid money out of the hands of the Commissioners without paying the labor and materialmen.

NEW YORK STATE COMMISSIONER OF HIGHWAYS MAY CANCEL ROAD CONTRACT WITH OTHER PARTY'S CONSENT

Construing the New York Highway Law, § 132, it is held, People v. Rockwood, 214 N. Y. S. 129, that the state highway commissioner has full discretionary powers in the matter of the construction of state highways, and, in the exercise of good faith, has the power to terminate as well as make construction contracts. Where the commissioner's cancellation of such a contract has been acquiesced in by the other party to the contract, it is at an end, and no liability of either party can be based thereon.

COUNCIL SOLE JUDGE OF EXPEDIENCY OF TAKING PROPERTY FOR STREET

The Circuit Court of Appeals, Fifth Circuit, holds that where a particular taking of property for a public use has been authorized by a body duly vested with power, such as the taking of property by the council of a municipality for a street, a court is without jurisdiction to supervise the determination of that body as to the necessity or expediency of taking the property selected, or to prevent the taking on the ground that the action of such body in selecting the property to be taken was influenced by a purpose to benefit one or more property owners, or to discriminate between property owners subject to be affected by the selection made. Atlantic Coast Line R. Co. v. Town of Sebring, 10 F. (2d) 679.

MATERIALMAN'S RIGHT OF ACTION AGAINST CONTRACTOR'S SURETY UNDER CONTRACT

In New Mexico no right to a lien exists in favor of laborers and materialmen on state contracts. Where a construction contract provided that under the contract and bond the contractor should pay for labor, material and supplies, a cement company was held to have a cause of action against the contractor and the surety company on the bond where the contractor failed to pay for the cement.—Southwestern Portland Cement Co. v. O. C. McElrath Const. Co., 11 F. (2d) 910.

MATERIALMAN'S REMEDY ON PUBLIC WORKS CONTRACT UNDER OHIO STATUTE WHERE CONTRACTOR DEFAULTS

Where a contractor on a public works contract defaulted, the Circuit Court of Appeals, Sixth Circuit, holds, Royal Indemnity Co. v. Cliff Wood, Coal & Supply Co., 10 F. (2d) 501, that,

under Ohio Gen. Code §§ 11242, 11258, a materialman could maintain an action on the surety alone for labor or material, although principal and surety were jointly and severally bound by the bond. The materialman was not required to furnish the surety with a statement of the amount due where the contract was abandoned and the work never accepted, so that the Ohio Statute requiring such a statement within ninety days after acceptance could not be complied with.

LIABILITY FOR INJURIES CAUSED BY APPLIANCES IN PARKS

The West Virginia Supreme Court of Appeals holds Warden v. City of Grafton, 128 S. E. 375, that it is the duty of a city owning and operating a public park under authority granted by its charter to exercise ordinary care in the construction and maintenance of mechanical appliances erected therein for the amusement and recreation of the public frequenting such park, and for a breach of such duty the city will be liable in damages to one injured while using such appliance for the purpose for which it was intended.

In some states the courts have refused to hold municipalities liable for such injuries, on the ground that in maintaining the parks they are acting in a governmental, and not in a private capacity.

REGULATION OF MUNICIPALLY OWNED WATER UTILITIES

The Wisconsin Railroad Commission established water rate schedules for the plant of the village of Shell Lake, holding that the Commission has jurisdiction under the Public Utility Law to regulate municipally operated public utilities and is required to fix reasonable and just rates for water service in such a case and that rates must be filed and existing legal rates cannot be modified without authority.

It provided that the utility should at the option of either the consumer or itself place all large consumers on metered rates, flat rates not being satisfactory for such consumers.

The Wisconsin Commission holds, Garner v. Village of Bloomington, that all residents of a village operating a water utility are entiitled to water service under reasonable terms and conditions, and the Commission has power to order necessary extensions if refused by the municipal utility.

The Utah Public Utilities Commission says, in authorizing the City of St. George to increase its water rates, that while, under the Public Utilities Act, municipal owned water works come under the jurisdiction of the Public Utilities Commission, and are to be regarded as "public utilities," subject to the same regulations as "water corporations" in general, the Commission has heretofore been loath to interfere with their direct regulation by the local authorities.

The Commission approves of a measured water service. It says: "The metered system is the only practical one whereby the amount of water used by a customer can, with any degree of accuracy, be determined. Flat rates manifestly ordinarily must work a hardship upon either the consumer or the utility."

Only one minimum charge, it is held, should be made, and that at the curb for each building, whether used for residence or business purposes, under the metered system.

CHARGE FOR SPRINKLER SYSTEM HELD PROPER

The New Jersey Public Utility Commissioners, Schwarzenbach-Huber Co. v. Hackensack Water Co., hold that a charge for sprinkler service is proper, whether the water is actually used or merely made available for use.

RIGHT TO DISPOSE OF PROPERTY DONATED FOR PUBLIC PARK PURPOSES

Where an owner of land deeded it to a town to be used "for public park purposes" and on the condition that if it were put to any other purpose it should revert to the owner, the Washington Supreme Court held, State v. Superior Court, 238 Pac. 985, that the municipality had no power to authorize a railroad company to build a railroad on the property, the provisions of Rem. Comp. Stat., §9175, authorizing the municipality to dispose of property received by it "for the benefit of the town" relating to "property which the city acquires for its ordinary municipal purposes, property the title to which it holds in fee, and over which it may exercise the rights belonging to and following ownership in fee, and do not relate to property which it acquires in trust for a specifically designated purpose, and over which it has only the powers of a trustee. This for the reason that it is a general grant of power with respect to its property, not a special grant with respect to property dedicated to it for a special use or purpose."

SEWER CONSTRUCTION CONTRACT HELD NOT DIVISIBLE INTO UNITS

The North Dakota Supreme Court holds, State v. City of Hankinson, 205 N. W. 995, that where a municipality enters into a contract for the construction of a sewer system consisting of sewer pipe, manholes, septic tank, sludge bed, etc., the contract is not divisible on the basis of the various units of construction so as to warrant a final award to the contractor based upon the completion of one or more units, while the entire contract is incomplete and unperformed.

ASSESSMENT OF RAILROAD RIGHTS OF WAY

There is a diversity of opinion as to the assessibility of a railroad right of way for street improvements. In some jurisdictions it is held that it is subject to assessment like other property, and that such property is conclusively presumed to be benefited by the improvement of a street on which it abuts. The majority of the more recent decisions, however, hold that the liability of a railroad right of way to assessment for a street improvement depends on whether it is benefited by the improvement, it being liable in that case and not otherwise—City of Alcox v. Louisville & N. R. Co., Tennessee Supreme Court, 274 S. W. 1110.

DRAINAGE OF SURFACE WATER FROM HIGHWAY

A landowner may drain his land of surface water by artificial drains, provided reasonable care be taken to avoid unnecessary injury to the land of his neighbors; and in disposing of surface waters, a town has the same rights and is subject to the same liabilities as an individual. A basin or depression within highway limits contained a land-locked pool of surface water which could be drained only by artificial means. The Minnesota Supreme Court, Sandmeier v. Town of St. James, 205 N. W. 634, held that the ditch dug and the tile laid to drain the basin did not coincide with the natural course of drainage was not a controlling feature in determining whether the town exceeded its legal rights. The town was not obliged to drain the highway in any particular direction. Its officers had the right to select any method of drainage which was reasonable and proper, and which eventually brought the water to a natural highway.

RATIFICATION OF UNAUTHORIZED ACT OF MEMBER OF BOARD

The Minnesota Supreme Court holds, Reed v. Monticello Tp., 205 N. W. 258, that in the absence of a statute authorizing one member of a town board to act for the town, the town can be bound only when the board acts at a meeting of its members. But if it was within the power of the board to bind the town and a single member assumed authority to do so, his acts may be ratified, and the ratification will bind the town to the same extent as if there had been previous authorization by the board. The auditing and paying by a town board of a workman's bill for removing, by direction of a member of the board, brush growing along the sides of a town road were held a ratification of the unauthorized employment, justifying the Industrial Commission in finding that the relation of employer and employee existed between the town and the workman, who was injured while removing the brush.

PARKING OF AUTOMOBILES

An ordinance prohibiting the parking of automobiles used for carrying passengers for hire is not authorized by a statute authorizing municipalities to regulate the parking of vehicles on the streets, and declaring invalid any ordinance containing provisions in conflict with the statute. —Baker v. Hasler (Mo. App.) 274 S. W. 1095.

AUTHORITY TO APPORTION ASSESSMENTS FOR PUBLIC IMPROVEMENTS

The Missouri Supreme Court holds that while assessments for special benefits and for local improvements in a broad sense are referable to the taxing power, yet they are not taxes in the general acceptation and use of that term, which usually applies to imposts levied for revenue or governmental purposes only.

The determination of what property of the citizens will be benefited by condemnation or other similar public improvements, and the actual benefits accruing to each particular tract may, it is held, be legally delegated by the legislature to any appropriate agency, including judicial offices and even to courts themselves as agents of the taxing authority. —Schwab v. City of St. Louis, 274 S. W. 1058.

UNDERESTIMATE OF YARDAGE—EFFECT ON GRAVELING CONTRACT

Where a contractor agreed in writing to gravel a highway a certain distance for a lump sum, it was held, Ariss-Knapp Co. v. Sonoma County, 238 Pac. 752, that it could not recover an additional sum because the county engineer underestimated the yardage in the notice to bidders, the prospective bidders being referred for full details of the work to the plans and specifications, which would have disclosed the discrepancy, and the notice to bidders containing data from which the yardage could have been computed. The contract containing a declaration that the contractor had seen and examined the plans and specifications, evidence of a custom of contractors to rely upon estimates of engineers and not to make independent investigation was held inadmissible.

STATUTORY RIGHT TO ACQUIRE PUBLIC UTILITY ON EXPIRATION OF FRANCHISE HELD PERMISSIVE, NOT MANDATORY

The Circuit Court of Appeals, Eighth Circuit, holds that Iowa Code, Supp. 1913, Section 722, providing that, if the contract or franchise of any heating plant, waterworks, gasworks, electric light or electric power plants in any city or town, not publicly owned, shall have expired or been surrendered, and the owner and the municipality cannot agree upon terms of purchase, the city or town may, by resolution, proceed to acquire such plant by condemnation, is permissive merely, and not mandatory, and the power to exercise the privilege or not to exercise it rests entirely in the judgment and discretion of the city officials, and their decision is final and conclusive.—City of Villisca, Iowa v. Iowa Service Co., 6 F (2d) 455.

VALIDITY OF COUNTY ROAD IMPROVEMENT BONDS

A bona fide purchaser of municipal bonds for a valuable consideration, without actual notice of any defense to them, is not bound to do more than to see that there was legislative authority for their issue, and that the officers who were thereunder authorized to issue them have decided that the precedent conditions upon which the grant was allowed to be exercised have been fulfilled. In cases where the bonds do not contain recitals importing compliance with the law, but show on their face the amount of the issue, and there are available to the purchaser data for ascertaining whether the issue was in fact authorized, the county issuing them is not estopped from asserting invalidity against the holder, as where the issues exceed constitutional limitations, and the question of power is involved. Obviously a county is not estopped from pleading invalidity, even against innocent holders, if the bonds are issued under an invalid statute. In the present case, power had been conferred by statute. The amount did not exceed the per-

missible percentage of taxable values. The county court was charged with the duty of determining whether there had been a fulfillment of the condition of approval by the voters of the county. The recital on the face of the bonds that they were issued in conformity with all the requirements of the statute was a determination of that question as to innocent purchasers.—Henderson County, Tenn. v Sovereign Camp, W. O. W., C. C. A. Sixth Circuit, 12 F (2d) 883.

SALE BY CITY OF WATER TO CONSUMERS OUTSIDE CITY LIMITS

The New York Appellate Division, Western New York Water Co. v. City of Buffalo, 213 App. Div. 458, affirming 208 N. Y. S. 387, holds that the jurisdiction of a municipality and the functions it exercises, either governmental or proprietary, are, in general, limited to the boundaries established by the statute incorporating it, unless extended by express legislative grant. In the state of New York it seems to be the general policy that if municipalities owning their own waterworks system desire the right to sell water to persons outside their territorial limits, they must obtain such power from the Legislature. Village Law, Sections 232, 236. Likewise, the power of private corporations to sell water to consumers in any given locality depends upon legislative grant. Transportation Corporations Law, Sections 80-85. The court did not find in any statute giving the city the right to furnish water to its inhabitants any provisions from which it might fairly be implied that it might sell water to persons for consumption outside the city limits; and it did not acquire such right by purchasing the property of a waterworks company.

RECOVERY FOR WORK OUTSIDE OF PAVING CONTRACT

A road contractor knew that a bridge, not included in his paving contract, was to be torn down and rebuilt by the town. His contract included parts of the state highway on each side of the bridge and provided that he was fully informed of conditions affecting the work. The New York Court of Claims holds, Hogeboom & Campfield v. State, 124 Misc. 559, 208 N. Y. S. 648, that he could not recover for the additional cost of hauling material resulting from dividing the work into two parts because of the bridge construction. He was, however, held entitled to recover the cost of filling in the bridge approaches, although the work was not strictly within his contract, on the theory that he thereby mitigated the damage which would have been caused by a long delay.

STATUTE LIMITING BOND ISSUE HELD NOT TO LIMIT COST OF CONSTRUCTION OF LIGHTING PLANT

In constructing water and light plants a village acts in its purely private business capacity to supply itself and its inhabitants with water and light, and its measure of liability is the same as that of a private individual or corporation under like circumstances.

Nebraska Laws, 1919, c. 181, authorizes municipalities to purchase or construct lighting systems and to defray the cost by a tax of 5 mills on the dollar valuation, or, if that is insufficient, by the issue of bonds not to exceed 10 per cent. of the taxable value of the property in the municipality. The Circuit Court of Appeals, Eighth Circuit, Village of Oshkosh v. Fairbanks, Morse & Co., 8 F (2d) 329, holds that the restriction on the amount of bonds that may be issued is not a limitation on the cost of the plant, nor a limitation on the express power given to the village to contract for the construction of a plant. Whether or not there was any legal method by which the contractors could compel payment, it was held that they were entitled to have their claims adjudicated and put in permanent form of judgments, based on the contractual obligations of the village.

FUEL YARD ORDINANCE HELD ARBITRARY AND INVALID

The federal district court for Oregon holds, Heerdt v. City of Portland, 8 F (2d) 871, that it is within the power of a city council, in its exercise of police regulations, to determine what shall constitute, under certain conditions, a fire hazard, and to provide suitable regulations for the protection of the public, though it may comprise a delimited area to be affected thereby. An ordinance prohibiting the maintenance of fuel yards in residential districts without a permit is held within such power. It is held, however, that such an ordinance is defective in assuming to authorize the city council to grant a permit to maintain such a yard, which would give the city arbitrary power respecting private property, in violation of the federal Fourteenth Amendment.

CITY HELD LIABLE FOR DAMAGES ARISING FROM OPERATION OF STREET LIGHTS

The Federal district court for southern Texas holds, Rowan v. City of Galveston, 13 F (2nd) 257, that a cause of action may be laid against a city for damages arising from the operation by the city of street lights, although the city does not conduct a light plant for profit or sell light to its inhabitants. In the absence of any decision of the Supreme Court of the United States or the Texas Supreme Court on the precise question, the court concludes that the city, in such a case, is liable because engaged in a proprietary rather than a governmental business. The court is of opinion that, while there is justification for the holding that the ordinary activities of municipal police and fire departments are governmental and not proprietary, and the city should not be charged with the acts of these departments as its agents, "there never was any reason for extending that doctrine to streets, as in some states, notably Michigan and the District of Columbia, and, specifically, there never was any reason for extending the doctrine, even to police, fire, schools, and other such public activities, when complicated and dangerous instrumentalities are used by the city in connection with those functions."